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GEOLOGY.—*The Pleistocene Horry clay and Pamlico formation near Myrtle Beach, S. C.*[1] C. WYTHE COOKE, U. S. Geological Survey.

In my recently published report on the geology of the Coastal Plain of South Carolina, the statement is made that late Pleistocene Pamlico time, during which the sea stood about 25 feet above its present level, was preceded by a time of lower sea level.[2] This statement was based on evidence that came chiefly from outside of South Carolina, for I had not seen a contact of the Pamlico formation with underlying beds within the State. Since that report went to press, the canal of the Intracoastal Waterway mentioned on page 125 has been completed through Horry County. The following instructive section on it yields evidence that corroborates that statement.

SECTION WEST OF THE RAILWAY BRIDGE ACROSS THE INTRACOASTAL WATERWAY 2½ MILES NORTHWEST OF MYRTLE BEACH, S. C.

	Feet
Pamlico formation:	
3. Fine leached marine sand including a few thin beds of clay in the middle part and merging upward into clayey loam	12
2. Fine sand loaded with sea shells, many of which have both valves in juxtaposition. The upper part contains many oysters	6
Horry clay:	
1. Very dark brown clay containing comminuted plant fragments and woody tissues and diatoms. Cypress stumps and knees are rooted at the top. Some of the stumps extend a few inches above the clay into the overlying shell bed. The top of the clay is perforated by tubular holes, presumably made by boring creatures. Covered by water at high tide	3

The presence of rooted tree stumps beneath a thick marine deposit that evidently accumulated in quiet water gives conclusive evidence that the sea stood lower on the land when they grew than in the immediately succeeding epoch.

The name Horry clay, here used for the first time, is proposed

[1] Published by permission of the Director of U. S. Geological Survey. Received October 6, 1936.

[2] COOKE C. W., U. S. Geol. Survey Bull 867: 157. 1936.

for bed 1. It is pronounced O-ree, with the accent on the last syllable, as in Horry County, S. C., from which it is adopted.

The Horry clay contains a large flora of diatoms. A small sample studied by Kenneth E. Lohman of the U. S. Geological Survey yielded the 53 species in the following list:

A—abundant; C—common; F—few; R—rare; *—now living in fresh or brackish water; species not preceded by an * are marine.

Melosira cf. *M. recedens* Schmidt (F), *M. sulcata* (Ehrenberg) Kützing (C), *Podosira stelliger* (Kützing) Mann (C), *Cyclotella striata* (Kützing) Grunow (F-C), *C. striata bipunctata* Fricke (F), *C.* sp. (F), *Coscinodiscus denarius* Schmidt (F), *C. excentricus* Ehrenberg (F), *C. nitidus* Gregory (F), *C. oculus-iridis* Ehrenberg (F), *C. radiatus* Ehrenberg (F), *Actinoptychus parvus* Mann (R), *A. splendens* (Shadbolt) Ralfs (R), *A. undulatus* Ehrenberg (F), *Polymyxus coronalis* Bailey (A), *Aulacodiscus argus* (Ehrenberg) Schmidt (F), *Eupodiscus* cf. *E. decrescens* Rattray (R), *Auliscus pruinosus* Bailey (R), *Actinocyclus ehrenbergii* Ralfs (F), *Triceratium favus* Ehrenberg (F), *T. reticulum* Ehrenberg (F), *Biddulphia* cf. *B. rhombus* (Ehrenberg) Wm. Smith (F), *B.* sp. (R), *Grammatophora* sp. (R), *Plagiogromma* sp. (R), *Rhaphoneis amphiceros* Grunow (C), *R. belgica* (R), *R.* aff. *R. angularis* Lohman (C), *R. surirella* Grunow (R), *Synedra investiens* Wm. Smith (R), *Leudugeria janischii* (Grunow) Van Heurck (R), **Eunotia monodon* Ehrenberg (R), *Cocconeis scutellum* Ehrenberg (R), **Diploneis elliptica* (Kützing) Cleve (R), *D. gründleri* (Schmidt) Cleve (R), *D. weissflogii* (Schmidt) Cleve (F), **Frickea lewisiana* (Greville) Heiden (R), *Trachyneis aspera* Ehrenberg (R), **Navicula peregrina* (Ehrenberg)Kützing (R), *N.* aff. *N. spectabilis* Gregory (R), *N.* sp. (R), **Caloneis formosa* (Gregory) Cleve (R), **Gyrosigma acuminatum* (Kützing) Rabenhorst (R), **G.* cf. *G. balticum* Ehrenberg (R), *G.* sp., *Pleurosigma* sp. (F), *Amphora pediculus* (Kützing) Grunow (R), **Epithemia zebra porcellus* (Kützing) Grunow (R), **E. zebra saxonica* (Kützing) Grunow (R), **Rhopalodia gibberula* (Ehrenberg) Müller (R), **Nitzchia granulata* Grunow (R), **N.* cf. *N. plana* Wm. Smith (R), **N. tryblionella* Hantzsch (R).

Mr. Lohman comments on this flora as follows:

"The facts that the fresh- and brackish-water species are all rare in the Horry clay and that the marine species are abundant indicate a marine to slightly brackish environment at the time of deposition, such as would be found in the seaward part of an estuary or bay beyond the influence of any major fresh-water stream that may have emptied into it. The most abundant species, *Polymyxus coronalis*, is now known to be living only in the tropics, and this is true also of several of the others, strongly suggesting that the Horry clay was deposited under conditions at least as warm, and most probably warmer, than those existing in the same region today.

"*Polymyxus coronalis* occurs abundantly in the Pleistocene beds penetrated by a well drilled at Wildwood, N.J., at a depth of 78–180 feet. It also occurs sparingly in the "blue clay" at Philadelphia, which represents its northernmost known occurrence. This species is extinct along the Atlantic coast of North America, and so far as known is living only off the mouths

of the Para and Amazon rivers. It has never been found in rocks older than Pleistocene. Another common species, *Triceratium favus*, has a known range of Pleistocene to Recent. Many other species in the assemblage also occur in Pleistocene beds in the Atlantic Coastal Plain, but most of them are long-ranging species having little significance for age determination."

The peaty appearance of the clay and the cypress stumps rooted in it would lead one to suppose that the clay had accumulated in a cypress swamp; but all the trees are rooted in the top of the deposit, and all the common species of diatoms are marine. It is therefore evident that the clay was deposited in salt water. Before the cypress trees could have taken root there must have been either a lowering of sea level or a freshening of the water due to other causes. The clay may represent the deposits of a salt marsh that eventually was changed into a fresh-water swamp by the building of barriers across the tidal inlets.

As the diatom flora includes several tropical species, it is hardly likely that the clay could have been deposited during a glacial stage. It more probably represents part of an interglacial stage, presumably the early part of that including Pamlico time, after sea level had risen from the low of the preceding glacial stage to approximately its present height but before it had attained its maximum of 25 feet above the present level. The trees may have grown in a flooded estuary freshened toward the end of a brief pause in the submergence.

Further flooding of the estuary in which the Horry clay was deposited widened it into a V-shaped bay opening towards the southwest. The bay was separated from the Atlantic Ocean by a low, narrow peninsula composed (at Myrtle Beach) of coarse reddish-brown sand containing disc-shaped, flat pebbles. In the "Geology of the Coastal Plain of South Carolina"[3] I interpreted this peninsula and the higher land across the bay as having been built above water by the waves and winds of Pamlico time. In the light of newer evidence it seems more likely that they are of Talbot age and that the Horry estuary occupied a valley in the Talbot plain.

A somewhat similar occurrence of diatomaceous clay and cypress stumps overlain by marine fossiliferous sand (Pamlico formation) is reported by Mansfield[4] on the Neuse River about 10 miles below New Bern, N. C. At this place, however, *Nitzschia scalaris*, a fresh-water species, predominates. The presence of at least two marine

[3] U. S. Geol. Survey Bull. 867: 7, 153: pls. 1, 4, 17. 1936.
[4] MANSFIELD, W. C., U. S. Geol. Survey Prof. Paper 150: 134. 1928.

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species there indicates that the deposit was formed in an estuary to which salt water had occasional access. Although the incomplete list of the diatoms on the Neuse includes no species listed from the Horry clay near Myrtle Beach, the two deposits are probably contemporaneous, for both are estuarine, both underlie the marine Pamlico formation, and they stand at the same level. If they are contemporaneous, they yield further evidence that there has been no tilting of late Pleistocene deposits in the Carolinas.

The lower part of the Pamlico formation at the railroad bridge near Myrtle Beach (bed 2 of the section) is highly fossiliferous. Many of the fossils are well preserved and larger than the usual sizes that the same species attain along the Carolina coast today—an indication of warmer water. Among the organisms represented are unidentified corals; unusually large sand dollars (*Mellita quinquiesperforata*); and more than 60 species of mollusks, some of which (e.g. *Rangia cuneata*) no longer live in the Atlantic Ocean. For the identification of the mollusks listed below I am indebted to Dr. W. C. Mansfield. The collection is especially valuable because all of the specimens were found in place, without possibility of contamination from other beds. As many of the bivalves retain both shells in juxtaposition, it is unlikely that any of them were reworked.

Acetocina canaliculata (Say), *Terebra dislocata* (Say), *T. concava* (Say), *Mangelia cerina* Kurtz & Stimpson, *Marginella* sp. (immature), *Olivella nitidula* Dillwyn, *Oliva sayana* (Ravanel), *Busycon caricum* (Gmelin), *B. caniculatum* (Linnaeus), *Cantharus cancellaria* (Conrad), *Alectrion acuta* (Say), *A. trivittata* (Say), *Ilyanassa obsoleta* (Say), *Anachis avara* Say, *A. obesa* C. B. Adams, *Mitrella lunata* (Say), *Urosalpinx cinerius* (Say), *Odostomia* sp. *Turbonilla* sp., *Seila adamsii* (H. C. Lea), *Littorina irrorata* Say, *Crepidula fornicata* (Linnaeus), *C. fornicata ponderosa* H. C. Lea, *Polinices duplicatus* (Say), *Tectonica pusilla* (Say)?, *Sinum perspectivum* (Say), *Glycymeris* sp. (young), *Argina pexata* Say, *Arca transversa* Say, *Noetica ponderosa* Say, *Fossularca adamsi* Dall, *Ostrea virginica Gmelin, Pecten gibbus gibbus Linnaeus, Anomia simplex* d'Orbigny, *Modiolus* sp. (fragment), *Pandora trilineata* Say, *Venericardia tridentata* Say, *V. perplana* Conrad, *Phacoides multilineatus* Tuomey & Holmes, *P. radians* (Conrad), *P. trisculatus* Conrad, *Divaricella quadrisulcata* (d'Orbigny), *Rochefortia* sp., *Cardium muricatus* Linnaeus, *C. robustum* Solander, *Dosinia discus* Reeve, *Chione cancellata* (Linnaeus), *Venus mercenaria* Linnaeus, *Gemma purpurea* H. C. Lea?, *Tellina* sp. cf. *T. sayi* Deshayes, *Semele proficua* Poulteney, *Abra aequalis* (Say), *Donax variabilis* Say, *D.* sp., *Spisula similis* Say, *Mulinia lateralis* Say (very abundant), *Rangia cuneata* Gray, *Ervilia concentrica* Gould, *Corbula contracta* Say, *Barnea costata* Linnaeus.

The contact between beds 2 and 3 of the section near Myrtle Beach apparently marks the location of the top of the saturated

zone before the canal was dug. The absence of shells above this level may be attributed to the leaching action of rain water that, in percolating downward, dissolved the shells. The absence of shells from terrace deposits higher than the Pamlico has been advanced as an argument against the marine origin of the higher terraces; but most of the higher terrace deposits are porous and have been subjected to leaching for a longer time than the Pamlico formation.

The sequence of late Pleistocene events that can be inferred from the sections near Myrtle Beach, on Neuse River, and from other evidence is as follows: First, a lowering of sea level from the 42-foot Talbot stage to a depth estimated by Stearns[5] as about 60 feet below the present level; next, a rise of sea level to approximately its present position and deposition of the Horry clay in estuaries filling valleys cut in the Talbot terrace during the preceding epoch; then, continued rise of sea level to a height of 25 feet, expansion of the Horry estuaries, and deposition of the Pamlico formation; next, fall of sea level to a depth at least 25 feet lower than the present, indicated by submerged channels in Pamlico Sound and elsewhere; finally, rise of the sea to its present level, drowning the valleys and lowlands of the preceding epoch to form the existing sounds and estuaries.

I have elsewhere[6] tentatively correlated the Pamlico formation with the last major interglacial stage, commonly called Peorian—a correlation that seems to be confirmed by the studies of MacClintock and Richards.[7] The Horry clay apparently represents the early part of the same stage.

PALEONTOLOGY.—*Pliocene and Pleistocene mollusks from the Intracoastal Waterway in South Carolina.*[1] W. C. MANSFIELD and F. S. MACNEIL.

In June, 1935, and again in April, 1936, the writers visited the Intracoastal Waterway at North Dam (Location Contract 195) about 3 miles west-southwest of Little River and about 15 miles northeast of Myrtle Beach, S. C. The canal here traverses a low plain, which as interpreted by Cooke,[2] is the southward continua-

[5] STEARNS, H. T., Geol. Soc. Am. Bull. **46**: 1941. 1935.

[6] COOKE, C. W. *Tentative ages of Pleistocene shore lines.* This JOURNAL **25**: 333. 1935.

[7] MACCLINTOCK, PAUL, and RICHARDS, H. G. *Correlation of late Pleistocene marine and glacial deposits of New Jersey and New York.* Geol. Soc. Am. Bull. **47**: 317. 1936.

[1] Published by permission of the Director, U. S. Geological Survey. Received October 12, 1936.

[2] COOKE, C. W. *Geology of the Coastal Plain of South Carolina.* U. S. Geol. Survey Bull. **867**: 125–126. 1936.

Fig. 1.—Intracoastal waterway canal, June, 1935, at North Dam (Location contract 195) about 3 miles west-southwest of Little River and about 15 miles northeast of Myrtle Beach, S. C. The rock on which the senior author stands is referred to the Pliocene epoch (see No. 1 of section).

tion of the Pamlico terrace plain of North Carolina. The purpose of this paper is to record the species of mollusks collected at North Dam, both those in place from the different beds in the canal banks and those thrown out by the dredge along the spoil banks. These faunas are compared with those from other areas and certain species not heretofore recorded from this area are indicated.

The section exposed at this locality is as follows:

	Feet
Recent:	
6. Cross-bedded white to tan sand	8±
Pleistocene (Pamlico formation):	
5. Dark gray, rather fine clayey sand, carrying many fossils (U. S. Geol. Survey nos. 13424, 13813	3±
4. Sand (of dune origin?)	3±
3. Alternating layers of cross-bedded sand and peat, the peat in places grading laterally into sand	3±
2. Dark gray clayey sand, some of the sand grains large and irregular, carrying many individuals of *Mulinia lateralis*, *Ostrea virginica* and other shells; this bed changes laterally in character and thickness, being more clayey and fossiliferous where it occupies depressions in the underlying bed and more sandy and cross-bedded as it becomes thinner; in places the lower	

part of the carbonaceous bed (no. 3) rests directly on the Pliocene (bed 1) (U. S. Geol. Survey no. 13425)..... 0–3

Unconformity.

Pliocene (Waccamaw formation):

1. Indurated, light gray, highly calcareous marl with a minor amount of rather fine quartz sand, carrying fragmental and entire mollusks, corals, encrusting bryozoa and echinoderms (U. S. Geol. Survey no. 13426).....(above water level)..... 4±

The species collected from layers 1, 2, and 5, and from the spoil bank are listed below.

LIST OF SPECIES FROM LAYER 5

Aceteocina canalicula (Say), *Terebra dislocata* (Say), *Terebra concava* (Say), *Ilyanassa obsoleta* (Say), *Anachis avara* Say, *Epitonium angulatum* Say, *Melanella* sp., *Turbonilla*, 2 or more species, *Seila adamsii* (H. C. Lea), *Crepidula fornicata* (Linnaeus), *Nucula proxima* Say, *Arca transversa* Say, *Noetia ponderosa* (Say), *Argina pexata* (Say), *Ostrea virginica* Gmelin (?), *Anomia simplex* D'Orbigny, *Mytilus* sp., *Lyonsia* aff. *L. floridana* Conrad, *Phacoides multilineatus* Tuomey and Holmes, *Cardium robustum* Solander, *Cardium muricatum* Linnaeus, *Chione cancellata* (Linnaeus), *Venus* sp., *Venus mercenaria* Linnaeus, *Gemma purpurea* H. C. Lea, *Tellina* cf. *sayi* (Deshayes) *Dall*, *Semele proficua* Pulteney, *Cumingia tellinoides* (Conrad), *Tagelus gibbus* (Spengler), *Tagelus divisus* Spengler, *Mulinia lateralis* Say, *Anatina canaliculata* (Say), *Barnea* (*Scobina*) *costata* (Linnaeus).

This fauna is of very late Pleistocene age. Of the 26 species all, or nearly all, are now living somewhere along the Atlantic coast.

LIST OF SPECIES FROM LAYER 2

Acteocina canaliculata (Say), *Cylichnella bidentata* (D'Orbigny), *Terebra* sp., *Mangelia cerina* Kurtz and Stimpson, *Olivella nitidula* Dillwyn, *Marginella apicina* Menke, *Marginella* sp., *Busycon caricum* (Gmelin), *Busycon perversum* (Linnaeus), *Cantharus tinctus* Conrad, *Alectrion acuta* Say, *Alectrion trivittata* (Say), *Ilyanassa obsoleta* (Say), *Anachis obesa* C. B. Adams, *Mitrella lunulata* Say, *Urosalpinx cinerius* Say, *Eupleura caudata* Say, *Epitonium* sp., *Turbonilla*, 2 or more sp., *Semicassis inflata* Shaw, *Ficus papyratia* Say, *Triphora nigrocincta* C. B. Adams, *Cerithiopsis subulata* Montagu, *Vermicularia spirata* (Philippi), *Turritella* sp., *Crepidula fornicata* (Linnaeus), *Crepidula plana* Say, *Calyptraea centralis* Conrad (?), *Polinices* (*Neverita*) *duplicatus* (Say), *Diodora alternata* (Say), *Nucula proxima* Say, **Glycymeris americana* Defrance, **Arca lienosa* Say, *Arca transversa* Say, *Argina pexata* (Say), *Noetia ponderosa* (Say), "*Fossularca*" *adamsi* Dall, *Ostrea virginica* Gmelin, **Pecten eboreus solariodes* Heilprin, **Plicatula marginata* Say, *Cardita* sp. (young), **Cardita arata* (Conrad), **Venericardia granulata* Say, *Chama* sp., **Phacoides* cf. *P. waccamawensis* Dall, *Diplodonta semiaspera* Philippi, **Diplodonta acclinis* Conrad, *Bornia* cf. *B. triangulata* Dall, *Dosinia elegans* (Conrad), *Chione latilirata athleta* Conrad, *Venus* sp., *Tellina sayi* (Deshayes) Dall, *Cumingia tellinoides* (Conrad), *Abra aequalis* (Say),

Tagelus gibbus (Spengler), *Spisula* cf. *S. similis* Say, *Mulinia lateralis* Say, *Anatina canaliculata* (Say), *Corbula barrattiana* C. B. Adams, *Corbula contracta* Say, Coral.

The sediments of layer 2 were probably deposited during Pleistocene time. Of about 62 species listed, 8 are believed to have lived during Pliocene time (marked in the list with an asterisk*) and to have been redeposited in the Pleistocene sediments.

The water level in the canal was about 4 feet higher during our last than during our first visit and consequently the lower part of layer 2, seen during our first visit, was under water. All of the presumably reworked Pliocene species were collected during our first visit from depressions in the underlying Pliocene bed and at the time were thought to have been in place in the base of layer No. 2. However, the possibility that they may have slipped down the bank from overlying dredged material, is recognized.

The following species are not known to have lived earlier than Pleistocene time: *Busycon caricum* (Gmelin), *Cantharus tinctus* Conrad, *Alectrion trivittata* (Say), *Ilyanassa obsoleta* (Say), *Urosalpinx cinerius* Say, *Semicassis inflata* Shaw, *Argina pexata* (Say), *Noetia ponderosa* (Say), *Cumingia tellinoides* (Conrad), *Anatina canaliculata* (Say) and others.

LIST OF SPECIES FROM THE UPPER PART OF THE PLIOCENE, LAYER NO. 1

Olivella mutica Say, *Fusinus* cf. *F. carolinensis* Dall, *Ilyanassa porcina* Say, *Nucula proxima* Say, *Glycymeris americana* (DeFrance), *Pecten eboreus senescens* Dall, *Crassinella lunulata* (Conrad), *Venericardia abbreviata* Conrad?, *Phacoides multilineatus* (Tuomey and Holmes), *Diplodonta acclinis* (Conrad), *Cardium* sp., *Laevicardium mortoni* Conrad, *Venus* sp., *Tellina sayi* (Deshayes), *Mulinia lateralis* Say, *Poromya* sp., *Corbula barrattiana* C. B. Adams, *Corbula contracta* Say.

LIST OF SPECIES FROM THE SPOIL BANK

Terebra dislocata (Say), *Terebra* aff. *dislocata* (Say), *Terebra concava* (Say), *Conus adversarius* Conrad, *Conus floridanus* Gabb (C), "*Drillia*" *ebenia* Dall (C), "*Drillia*" aff. *pagodula* Dall (C?), *Cymatosyrinx lunata* (H. C. Lea), *Mangilia* sp., *Cancellaria* cf. *C. carolinensis* Emmons, *Oliva sayana* (Ravenel), *Olivella nitidula* Dillwyn, *Marginella* aff. *M. limatula* Conrad, *Scaphella* (*Aurinia*) *floridana* (Heilprin) (C), *Aurinia obtusa* Emmons, *Fasciolaria sp.* (N), *Fasciolaria apicina* Dall, *Busycon carica* Gmelin (P?), *Busycon perversum* (Linnaeus), *Busycon pyrum* Dillwyn, *Busycon* sp. (N), *Fusinus carolinensis* (Dall), *Fusinus* sp., *Alectrion acuta* (Say) (P), *Alectrion vibex* (Say) (C), *Ilyanassa obsoleta* (Say) (P), *Ilyanassa irrorata* Conrad, *Ilyanassa isogramma* Dall, *Alectrion* aff. *ambigua antillarum* D'Orbigny (C), *Anachis avara caloosaensis* Dall, *Ocinebra alta* Dall (C), *Eupleura caudata* Say (P), *Murex pomum* Gmelin, *Murex rufus* Lamarck, *Purpura fluvi-*

ana Dall (C), *Coralliophila lepidota* Dall, *Urosalpinx cinerius* (Say) (P), *Urosalpinx* sp. (N), *Ficus papyratia* (Say), *Petaloconchus irregularis* D'Orbigny (P), *Turritella subannulata* Heilprin, *Turritella* sp. (P?), *Crepidula fornicata* (Linnaeus), *Crepidula cymbaeformis* Conrad, *Crepidula plana* Say, *Polinices* (*Neverita*) *duplicata* (Say), *Natica canrena* Linnaeus, *Diodora* cf. *D. alternata* (Say), *Nuculana acuta* (Conrad), *Glycymeris americana* (DeFrance), *Glycymeris pectinata* (Gmelin), *Acar reticulata* Gmelin (C), *Arca plicatura* Conrad?, *Arca transversa* Say (P), *Arca lienosa* Say, *Arca rustica* Tuomey and Holmes (N), *Arca* (*Cunearca*) *incongrua* Say (P), *Argina pexata* Say (P), *Navicula umbonata* Lamarck (P?), *Navicula wagneriana* (Dall) (C), *Fossularca adamsi* Dall, *Noetia ponderosa* (Say) (P), *Ostrea sculpturata* Conrad, *Ostrea virginica* Gmelin (P), *Ostrea* aff. *O. trigonalis* Conrad, *Pecten eboreus senescens* Dall, *Pecten evergladensis* cf. *charlottensis* Mansfield (C), *Pecten eboreus solarioides* Heilprin (W), *Pecten ernestsmithi* Tucker (N), *Amusium mortoni* Ravenel, *Plicatula marginata* Say, *Anomia simplex* D'Orbigny, *Modiolus* cf. *M. gigantoides* Olsson (W), *Astarte concentrica* bella Conrad, *Crassinella dupliniana* Dall, *Crassinella lunulata* (Conrad), "*Eucrassatella*" *gibbesii* (Tuomey and Holmes), "*Eucrassatella*" *mansfieldi* MacNeil (C, N,W), *Cardita arata* (Conrad), *Venericardia granulata* Say, *Venericardia tridentata* Say, *Chama striata* Emmons, *Echinochama arcinella* (Linnaeus), *Phacoides radians* (Conrad), *Phacoides anodonta* (Say), *Diplodonta acclinis* Conrad, *Laevicardium sublineatum* (Conrad), *Cardium* cf. *isocardia* Linnaeus, *Cardium muricatum* Linnaeus (P), *Chione latilirata* Conrad, *Chione cribraria* (Conrad), *Chione cancellata* (Linnaeus), *Venus campechiensis permagna* Conrad, *Venus mercenaria* Linnaeus, *Macrocallista reposta* Conrad, *Tellina* cf. *T. propetenella* Dall, *Macoma balthica* Linnaeus (P), *Semele bella-striata* Conrad (C), *Semele proficua* Pulteney (P), *Semelina nuculoidea* Conrad (P?), *Tagelus gibbus* Spengler (P), *Spisula* aff. *similis* Say, *Mulinia lateralis* Say, *Corbula inaequalis* Say, *Barnea costata* Linnaeus (P).

The capital letters used in the preceding list are explained as follows: (P) probably Pleistocene; (C) present also in the Caloosahatchee marl (Pliocene) of western Florida but not previously reported from the Waccamaw formation in the adjacent area to the west of the canal; (N) present also in the Pliocene at Neills Eddy Landing, 5 miles N. E. of Acme, N. C.; (W) present also in the Pliocene in the upper bed at the north shore of Lake Waccamaw, N. C. Most of the species not followed by a letter probably came from the Pliocene as many of the specimens are incrusted with a hard matrix.

The close relationship of the Pliocene fauna or faunas dredged from the canal, to that of the Caloosahatchee marl of western Florida, to that at Neills Eddy Landing on Cape Fear River, N. C., and to that in the uppermost bed on the north shore of Lake Waccamaw, N. C., is indicated by the common occurrence at those localities of certain of the species as indicated in the list. The presence of *Navicula wagneriana* (Dall) is of particular interest as it has been known heretofore only in the Caloosahatchee marl.

No specimens of the genus *Rangia* were collected from the spoil

banks. The apparent absence of this genus, which inhabits shallow water, may indicate open and moderately deep water conditions for this area, during Pliocene and Pleistocene time.

Three species of mollusks (identified by W. C. Mansfield)—*Pecten ernestsmithi* Tucker, *Pecten eboreus senescens* Dall, and *Scaphella (Aurinia) floridana* (Heilprin), and one species and three specifically unnamed genera of echinoids—*Rhyncholampus evergladensis* (Mansfield), a *Clypeaster*, an *Encope* and a *Coelspleurus*, are recorded by Cooke[3] from this locality.

PALEONTOLOGY.—*A new subspecies of* Pecten *from the upper Miocene of North Carolina.*[1] W. C. MANSFIELD, U. S. Geological Survey.

In April, 1936, F. S. MacNeil and the writer obtained additional specimens of *Pecten*, among other material, from exposures along the Chowan River in Bertie and Hertford Counties, eastern North Carolina. The *Pecten* from certain localities, as noted below, was referred by the writer[2] to *P. (Chlamys) eboreus eboreus* Conrad, but he now believes, after procuring better specimens for comparison, that it should be referred to a new subspecies—*P. eboreus bertiensis*, described as follows:

Pecten (Chlamys) eboreus bertiensis Mansfield, n. subsp. Figs. 1–3

Shell large, thin, ovate, inequilateral; hinge line rather short; left valve much more inflated than right; ornamented with 24 to 25 ribs. Right valve of cotype low, ornamented with 25 flat ribs, which are medially shallowly incised over the middle part of the disk and separated by shallow interspaces which are a little narrower than the ribs. The concentric lamellae are moderately coarse. Right ear shallowly insinuated and marked with 5 rather strong radials, those near the hinge line being the stronger; left ear with 11 moderately strong radials. Left valve of cotype with 25 ribs, narrower than interspaces and medially sulcated over the middle part of the disk and nearly flat ventrally. Both ears with about 7 radials.

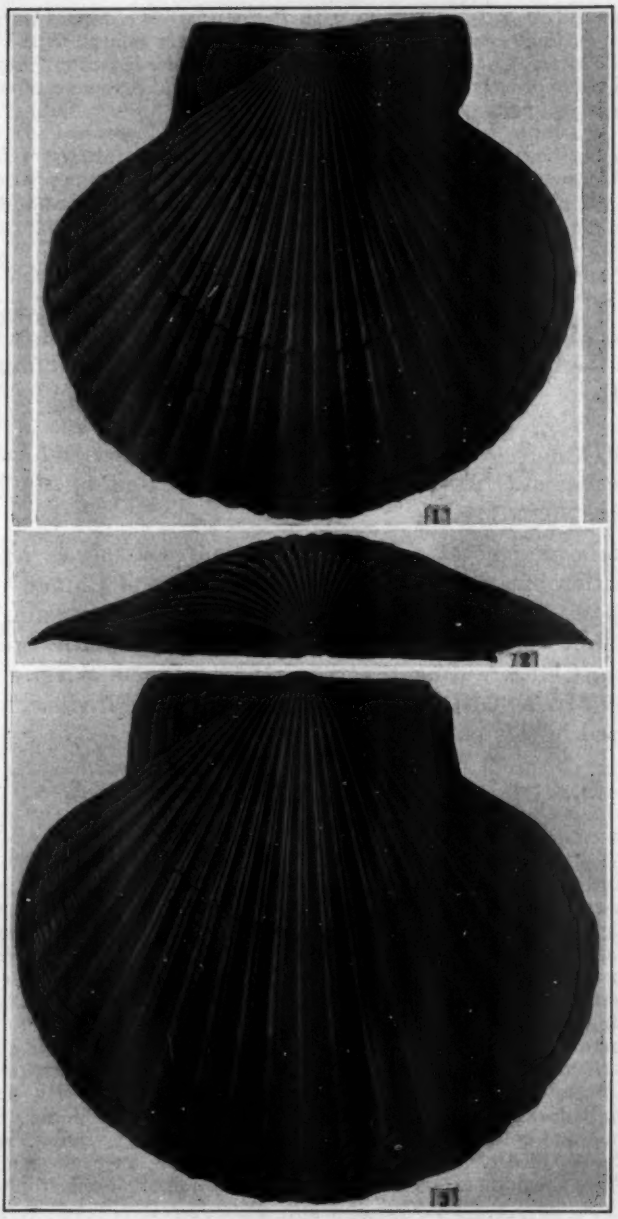
Dimensions of cotypes (U.S.N.M. no. 496224): Right valve, length 86 mm; height 80 mm; convexity 11 mm; length of hinge line 44 mm. Left valve, length 95 mm; height 88 mm; convexity 24 mm; length of hinge line 50 mm.

Type locality: Station 11999, from bed exposed at beach to 10 feet above in right bank of Chowan River, three-fourths of a mile below Mount Gould Landing, Bertie County, North Carolina.

[3] COOKE, C. W. *Geology of the Coastal Plain of South Carolina.* U. S. Geol. Survey Bull. 867: 126. 1936.

[1] Published by permission of the Director of the U. S. Geological Survey. Received December 2, 1936.

[2] MANSFIELD, W. C. *Stratigraphic significance of Miocene, Pliocene, and Pleistocene Pectinidae in the southeastern United States.* Jour. Paleontology 10 (3): 175, stratigraphic position 17, 1936.



Figs. 1–3.—*Pecten (Chlamys) eboreus bertiensis* Mansfield. n. subsp. Cotypes. 1, right valve. 2, 3, left valve. Slightly reduced.

The new subspecies intergrades with *Pecten eboreus eboreus* Conrad and *P. eboreus darlingtonensis* Dall, but it is more closely related to the former than to the latter. The left valve of the new subspecies is more inflated than the same valve of either of the above subspecies, and it is marked with incised ribs which neither one possesses.

Other occurrence in North Carolina: Station 12035 (lower bed), station 13814 (upper bed), Colerain Landing, Bertie County; station 1/1230, Tar Ferry, Wiccacon Creek, Hertford County; station 13798, upper bed at Beaver Dam Creek, Martin County; station 12004, Poplar Landing, Martin County.

The beds in which the new subspecies occurs are placed in the uppermost Miocene of North Carolina and are believed to have been deposited at a little later time than the Suffolk beds in Virginia at the north and about the same time as the Dupoin marl at the south.

ZOOLOGY.—*Notes on Chinese spiders of the families Salticidae and Thomisidae.*[1] IRVING FOX. (Communicated by C. F. W. MUESEBECK.)

The following notes and descriptions of new species represent continuation of a report on several collections of Chinese spiders in the possession of the United States National Museum. These spiders were collected chiefly by Dr. D. C. Graham in Szechwan Province, China, during the years 1923 to 1930. Several others taken by Mr. N. Gist Gee at Soochow, Kiangsu Province, are also considered in this paper.

Family SALTICIDAE

Myrmarachne grahami, n. sp. Figs. 1, 2

Female.—Total length, 7.13 mm. Chelicerae, .72 mm long. Carapace, cephalic part, 1.39 mm long, 1.29 mm wide, thoracic part, 1.29 mm long, 1.09 mm wide. Pedicel, .59 mm long. Abdomen, 3.97 mm long, 1.98 mm wide. Dorsum of the carapace dark brown, sides with a blackish tinge. The furrow that separates the two parts bears white wedge-shaped marks. Chelicerae brown, much lighter than the carapace. Endites orange with fringes of dark hair anteriorly, labium dark basally, whitish distally. Sternum dark brown contrasting strongly with the coxae which are yellowish. Legs orange; upper portion of the femora, the patellae, and tibiae of legs I with distinct dark longitudinal bands at the lateral surfaces; legs II having much less distinct lateral bands; legs III without lateral bands but with the coxae and femora darker at their distal ends. Dorsum of the abdomen blackish with numerous golden hairs, basally with an indistinct transverse stripe. At the basal third clear transverse light bands, one on each side, extend laterad from the dorsum, broaden at the sides and finally are lost in the light

[1] Received April 11, 1936.

venter. The venter bears a broad dark longitudinal band extending from the epigastric furrow to the spinnerets.

First row of eyes recurved, the eyes more or less contiguous, the median twice as large as the lateral. Ocular quadrangle wider than long (31/28), occupying about one-third the total length of the carapace. The eyes of the second row very small, closer to the anterior laterals than to the posterior laterals. Upper margin of the chelicerae armed with six teeth of which five are robust while the basal is weak, lower margin armed with seven teeth of which the basal five are close together while the other two are separated.

First pair of legs with 2-2-2-2 spines on the tibiae below, and 2-2 on the metatarsi below. Second pair of legs with 2-2-2 spines on the tibiae below and 2-2 spines on the metatarsi below. The third and fourth pairs are without spines. Legs, I, 4.18 mm; II, 2.96 mm; III, 3.52 mm; IV, 5.16 mm. For the structure of the epigynum see Fig. 2.

Type Locality.—China: female holotype from Suifu, Szechwan, Province 1000 ft., April 25, 1930 (D. C. Graham). Female paratype from Soochow, Kiangsu, Province (N. Gist Gee). *Type:* U.S.N.M. Cat. No. 1163.

This spider is related to *M. japonica* (Karsch) and resembles it in general coloration. It differs from that species, however, in the structure of the epigynum.

Myrmarchne gisti, n. sp. Figs. 4, 9, 12, 14

Female.—Total length, 8.02 mm. Chelicerae, .8 mm long. Carapace, cephalic part, 1.20 mm long, 1.16 mm wide, thoracic part, 1.36 mm long, .92 mm wide. Pedicel, 1.12 mm long. Abdomen, 3.86 mm long. 2.57 mm wide. Dorsum of the carapace dark and reddish brown, the cephalic part much darker than the thoracic and contrasting strongly with it. In the furrow that separates the two parts is found a wedge shaped mark on each side. Chelicerae concolorous with the thoracic part being reddish brown. Palpi with the basal joints brown while the distal have a bluish tinge and are distinctly iridescent. Labium and endites brown, sternum somewhat darker. Legs I clear whitish yellow above and below, with distinct bands on the prolateral surfaces of the basal portion of the femora, the patellae, tibiae, and metatarsi. Legs II the same as I except that the lateral bands are less distinct. Legs III with the coxae, trochanters, and femora dark brown above and below, the other joints concolorous with legs I and II except for a dark spot at the junction of the patella and tibia above. Legs IV with the coxae and trochanters clear whitish yellow above and below but darker at the sides; the femora, distal portions of the patellae, tibiae, and metatarsi brown. Basal third of the abdomen whitish or buff, giving off posteriorly a more or less triangular mark which is bifurcate at the broad side. Middle third of the abdomen dark brown, outlined anteriorly by the whitish basal third and posteriorly by a broad buff portion which is as wide as the dorsum at that place (Fig. 4). Distal portion of the abdomen dark brown, concolorous with the middle third. Venter of the abdomen with a wide median dark band that begins at a point farther than usual below the epigastric furrow and extends to the spinnerets. The space between the epigastric furrow and the beginning of the median band is clear white in color.

First row of eyes slightly recurved, the median eyes contiguous and more than twice as large as the lateral. Ocular quadrangle wider than long (32/25), wider behind than in front (32/29), and occupying about one-third the total length of the cephalothorax. Eyes of the second row very small, closer

to the anterior lateral than to the posterior lateral. Upper margins of the chelicerae armed with seven well separated teeth of which the basal three are diminutive while the distal four are robust; the animal's left chelicera armed with eight teeth on the lower margin of which the basal five are close together, animal's right chelicera armed with seven teeth. Legs, I, 4.08 mm; II, 3.32 mm; III, 3.68 mm; IV, 5.60 mm.

First pair of legs with 2-2-2-2 spines on the tibiae below, and 2-2 on the metatarsi below. Second pair of legs with 2-2-2 spines on the tibiae below, and 2-2 spines on the metatarsi below. The third and fourth pairs are without spines. For the structure of the epigynum see Fig. 14.

Male.—Total length, 8.71 mm. Chelicerae, 2.02 mm long, Carapace, cephalic part, 1.70 mm long, 1.50 mm wide, thoracic part, 1.32 mm long, 1.14 mm wide. Pedicel, .25 mm long. Abdomen, 3.07 mm long, 1.06 mm wide. Carapace light brown above, the cephalic part somewhat darker than the thoracic, the eyes on dark spots. Sides lighter, bearing at the furrow that separates the two parts a wedge-shaped mark consisting of white hairs. Chelicerae light brown, concolorous with the thoracic part of the carapace. Sternum and endites light brown, the labium darker, these parts contrasting strongly with the coxae and trochanters of the anterior pairs of legs which are almost white. Dorsum of the abdomen like the female in its coloration having a broad buff portion distally and a dark brown middle third, the design at the basal third not so distinct as in the female (Fig. 9). Abdomen constricted anteriorly and bearing light bands which run laterad in the margin of the constriction. Venter lightest at the epigastric furrow, thereafter darkening posteriorly, bearing evidences of a median longitudinal dark band.

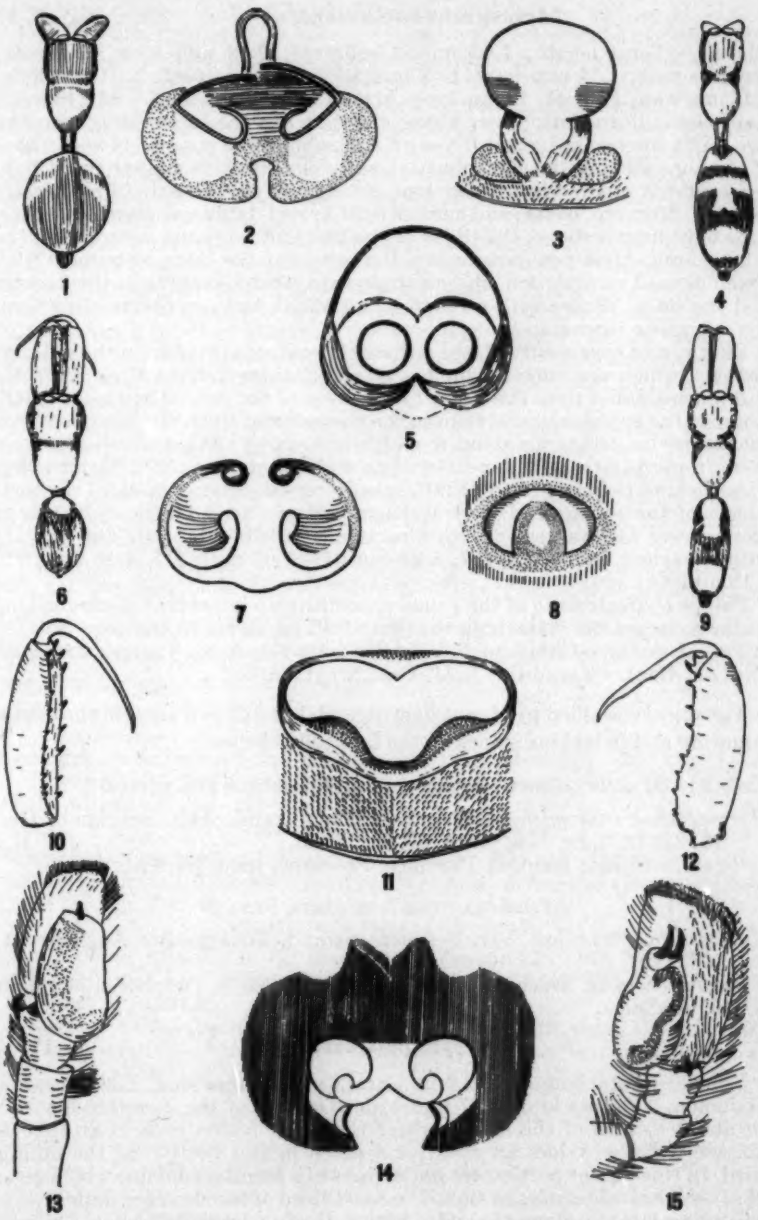
First row of eyes recurved, the anterior median closer to each other than to the anterior lateral and about twice the size of the latter. Eyes of the second row very small, closer to the anterior lateral than to the posterior lateral being removed from the former by a distance about five-sevenths as large as that which separates them from the latter. Ocular quadrangle wider than long (30/24), occupying more than one-third the total length of the cephalothorax, about as wide in front as behind. Chelicerae roughly wedge shaped, without a distinct lower margin, upper margin armed with ten teeth, of which the most distal points foward while the others are directed inward. For further details regarding the arrangement of the teeth see Fig. 12. The first pair of legs lacking, the second bears 1r-1r spines on the tibiae below. Legs, II, 3.27 mm; III, 4.10 mm; IV, 5.86 mm.

The palpal organ is characteristic of the genus, and presents little or no distinguishing features.

Type Locality.—China: female holotype and male allotype from Soochow, Kiangsu Province (N. Gist Gee). *Type:* U.S.N.M. Cat. No. 1164.

The unique design on the dorsum of the abdomen of this spider will serve to distinguish it from other oriental species of the genus.

Fig. 1.—*Myrmarachne grahami*, n. sp., female, dorsal view. Fig. 2.—*Myrmarachne grahami*, n. sp., epigynum. Fig. 3.—*Xysticus ephippiatus* Simon, epigynum. Fig. 4.—*Myrmarachne gisti*, n. sp., female, dorsal view. Fig. 5.—*Xysticus sicus*, n. sp., epigynum. Fig. 6.—*Myrmarachne vehemens*, n. sp., male, dorsal view. Fig. 7.—*Plexippus optabilis*, n. sp., epigynum. Fig. 8.—*Thomisus transversus*, n. sp., epigynum. Fig. 9.—*Myrmarachne gisti*, n. sp., male, dorsal view. Fig. 10.—*Myrmarachne vehemens*, n. sp., male, right chelicera. Fig. 11.—*Xysticus croceus*, n. sp., epigynum. Fig. 12.—*Myrmarachne gisti*, n. sp., male, left chelicera. Fig. 13.—*Rhene candida*, n. sp., male palpus. Fig. 14.—*Myrmarachne gisti*, n. sp., epigynum. Fig. 15.—*Rhene ipis*, n. sp., male palpus.



For explanation of Figs. 1–15, see bottom of opposite page.

Myrmarachne vehemens, n. sp. Figs. 6, 10

Male.—Total length, 7.62 mm. Chelicerae, 2.48 mm long. Carapace, cephalic part, 1.54 mm long, 1.63 mm wide, thoracic part, 1.19 mm long, 1.45 mm wide. Pedicel, .13 mm long. Abdomen, 2.90 mm long, 1.45 mm wide. Carapace uniform dark brown above, the sides and the suture separating the two parts somewhat lighter. Eyes on dark spots, the spaces between those of the anterior row and the clypeus densely clothed with white hairs. Chelicerae lighter, of a reddish-brown hue, oblong and parallel extending directly forward. Sternum, coxae, and endites light brown, labium somewhat darker. Legs light brown above, the tibiae of the first and last pairs darker than the other joints. Abdomen dark brown above and at the sides, anteriorly with a well defined constriction whose margins are much lighter than the dorsum and the sides. Venter with a broad longitudinal dark band extending from the epigastric furrow to the spinnerets.

First row of eyes recurved, the anterior lateral separated from the anterior median, which are subcontiguous, by about three-fourths their diameter and much smaller than the latter (5/8). Eyes of the second row very small, closer to the anterior lateral than to the posterior lateral being removed from the former by a distance about five-eighths as large as that which separates them from the latter. Ocular quadrangle wider than long (32/27), somewhat wider behind than in front (32/30), occupying more than one-third the total length of the carapace. Upper cheliceral margin armed with eight robust teeth, lower margin armed with nine smaller teeth (Fig. 10). The legs are without spines below. Legs, I, 5.24 mm; II, 3.66 mm; III, 4.40 mm; IV, 6.42 mm.

Palpus characteristic of the genus presenting no important distinguishing features; in general it is similar to that of *M. lugubris* (Kulcz.).

Type Locality.—China: male holotype from Soochow, Kiangsu Province. (N. Gist Gee). *Type:* U.S.N.M. Cat. No. 1165.

This species is allied to *M. patellata* Strand, but differs from it in the dental armature and in lacking spines on the first tibiae below.

MYRMARACHNE INNERMICHELIS Bösenberg and Strand

Myrmarachne innermichelis Bösenberg and Strand. Abh. Senckenb. Ges. **30**: 329 pl. 9, fig. 128, pl. 14, fig. 382, 1906.

Record.—China: Kiangsu Province, Soochow, male (N. Gist Gee).

MYRMARACHNE 7-DENTATA STRAND

Myrmarachne maxillosa var. *7-dentata* Strand. Zoologischer Anzeiger **31**: 568, 1907.

Record.—China: Szechwan Province, Suifu, 1000 ft. October, 1930, male (D. C. Graham).

Plexippus optabilis, n. sp. Fig. 7

Female.—Total length, 7.32 mm. Carapace, 3.27 mm long, 2.38 mm wide. Abdomen, 3.76 mm long, 2.47 mm wide. Dorsum of the carapace blackish for about a third of the length where the black region ends in an inverse triangle which provides an apex for a much lighter portion at the middle third. In this lighter portion are indications of a longitudinal line which gives off several branches on each side. The basal third of the carapace dark brown, expanding laterad along the sides giving them a brownish color. Clypeus

light with numerous long hairs. Chelicerae, sternum, and endites light brown, labium darker; coxae concolorous with the sternum but bearing dark markings at the sides. Legs orange, more or less annulate at the distal ends of the femora, patellae, and tibiae above; femora of the third and fourth pairs of legs with broad dark longitudinal bands on the prolateral surfaces. Dorsum of the abdomen with a median light band having anteriorly a longitudinal dark line, and breaking posteriorly into four large spots. Sides of the abdomen black and white, the white forming three more or less distinct stripes. Venter light with a distinct longitudinal dark band which is herringbone in pattern posteriorly.

First row of eyes slightly recurved, the medians closer to each other than to the laterals and about twice their size. Eyes of the second row midway between the anterior lateral and posterior lateral. Ocular quadrangle wider than long (43/32), about twice as wide before as behind, occupying more than one-third the total length of the carapace. Posterior lateral eyes about as large as the anterior lateral. Clypeus narrow, one-third the diameter of an anterior lateral eye. Each chelicera armed with a robust black tooth on the lower margin.

Tibiae I and II with 2-2-2 spines below, 1-1 on the prolateral surfaces, none above, metatarsi I and II with 2-2 spines below, none elsewhere; tibiae III and IV with 1-2 spines below, 2-2-2 above, metatarsi III and IV with 2-2 spines below, 2-2 above and 1 apical spine on each lateral surface. Legs, I, 5.00 mm; II, 4.24 mm; III, 5.56 mm; IV, 5.44 mm. For the structure of the epigynum see Fig. 7.

Type locality.—China: female holotype from Suifu, Szechwan Province, 1000 ft., October, 1930 (D. C. Graham). *Type:* U.S.N.M. Cat. No. 1166.

This species is referred to *Plexippus* because of its resemblance to *P. setipes* Karsch in general character. It differs from that species in the structure of the epigynum which is wider than long.

PLEXIPPUS CRASSIPES Karsch

Plexippus crassipes Karsch. Berliner Entom. Zeitschrift. **25**: 38. 1881.

Record.—China: Szechwan Province, Gongoshien, August 1, 1934, female (D. C. Graham).

PLEXIPPUS SETIPES Karsch

Plexippus setipes Karsch. Verh. Ver. Rheinl. **36**: 89. 1879.

Record.—China: Kiangsu Province, Soochow, 6 females (N. Gist Gee).

PLEXIPPUS PAYKULLI (Audouin)

Attus paykulli Audouin in Savigny, descr. Egypte **22**: 172. 1827.

Hyllus mimus Chamberlin. Proc. United States Nat. Mus. **63**: 33, pl. 7, fig. 50, 1924.

Records.—China: Szechwan Province, Suifu, 1000, ft., June 1925, female; Kiating, June, 1924, female (D. C. Graham). Kiangsu Province, Soochow, male (N. Gist Gee).

TELAMONIA BIFURCILINEA Bösenberg and Strand

Telamonia bifurcilinea Bösenberg and Strand. Abh. Senckenb. Naturf. Ges. **30**: 331 pl. 9, fig. 153, pl. 13, fig. 357, 1906.

Record.—China: Szechwan Province, Chungking, 2000 ft., May 6, 1930, female (D. C. Graham).

EVARCHA ALBARIA (L. Koch)

Hasarius albarius L. Koch. Verh. Zool-Bot. Ges. Wien **27**: 780 pl. 16, fig. 39, 1877.

Record.—China: Szechwan Province, South of Suifu, March 25, 1930, male (D. C. Graham).

Rhene ipis, n. sp. Fig. 15

Male.—Total length, 5.74 mm. Carapace, 2.38 mm long, 2.87 mm at the widest place. Abdomen, 3.37 mm long. 2.47 mm wide. Dorsum of the carapace with a median dark brown portion which is as wide as the first row of eyes anteriorly, and which tapers thereafter to the third eye row where it expands again so that it has almost its anterior width at the caudal end of the carapace. The regions about the posterior eyes are reddish. Surrounding all the eyes but present most thickly at the anterior row are numerous white hairs. Sides of the carapace dark brown with white hairs. Clypeus thickly covered with white hairs. Sternum, basal portion of the endites, and labium dark brown, distal portion of the labium and endites light brown. Legs more or less concolorous with the sternum below, the coxae are somewhat lighter. First pair of legs much heavier and darker than the others. Femora of the posterior legs contrasting strongly with the other joints which are lighter. Abdomen light brown above, with three pairs of large dark pits, posteriorly are indications of lateral white hairs. Sides of the abdomen with white hairs, more concentrated anteriorly. Venter light brown, sparsely clothed with white hairs.

First row of eyes recurved, the medians closer to each other than to the laterals and more than twice their size. Eyes of the second row small, very close to the anterior lateral eyes being removed by about a diameter of the latter. Third row of eyes slightly smaller than the width of the carapace at that place, the eyes somewhat larger than the anterior lateral. Ocular quadrangle wider than long (56/42), much narrower in front than behind (40/56), occupying about four-fifths of the entire length of the cephalothorax. Clypeus equal in height to about one-half the diameter of an anterior lateral eye. Chelicerae with a single dark robust tooth on the lower margins. Anterior tibiae and metatarsi with 2-2 spines below. Legs, I, 6.60 mm; II, 3.92 mm; III, 4.00 mm; IV, 4.56 mm.

The tibia of the palpus bears a small black apophysis distally. The bulb itself is provided with two processes anteriorly which are arranged so as to be pincer-like. For further details regarding the structure of the palpus see Fig. 15.

Type locality.—China: male holotype from between Kiating and Yachow, Szechwan Province, July 29, 1929; male paratype from Suifu, Szechwan Province, September, 1929; two male paratypes from Mupin, Szechwan Province, 3500 ft., July, 1929 (D. C. Graham). *Type:* U.S.N.M. Cat. No. 1167.

This species is allied to *R. atrata* (Karsch), but differs from that species in lacking a distinct and conspicuous design on the dorsum of the abdomen.

Rhene candida, n. sp. Fig. 13

Male.—Total length, 5.44 mm. Carapace, 2.67 mm long, 2.67 mm wide. Abdomen 2.97 mm long, 2.28 mm wide. The coloration of the carapace is similar to that of the previous species, *R. ipis*, but the central portion is not

so clearly demarcated from the lateral. In general the dorsum bears much fewer hairs, and in the alcoholic specimen these are not white. Sides of the carapace with distinct marginal stripes of white hairs. Each chelicera bears at its basal third a broad transverse band of white hairs. Sternum, coxae, labium and endites dark brown, labium with the distal portion lighter. The first pair of legs much darker and heavier than the others which are light brown below. The tarsi lighter, with black spots at the basal and distal ends. Dorsum of the abdomen light brown with indications of characteristic dark pits. The caudal end of the abdomen bears a pair of white bars on each lateral surface. Venter light brown with a white pubescence.

First row of eyes recurved, the medians closer to each other than to the laterals and about twice their size. Eyes of the second row very small, removed from the anterior lateral eyes by a distance greater than the diameter of the latter (6/5). Third row of eyes as wide as the carapace at that place, the eyes the same size as the anterior lateral. Ocular quadrangle wider than long (55/42), much narrower in front than behind (37/55), occupying about two-thirds the total length of the cephalothorax. Clypeus equal in height to three-fifths the diameter of an anterior lateral eye. Chelicerae with a single dark robust tooth on the lower margins. Tibiae and metatarsi I with 2-2 spines below. Legs, I, 5.20 mm; II, 3.80 mm; III, 3.68 mm; IV, 4.32 mm.

The bulb of the palpus is similar to that of *R. ipis*, but differs in the possession of a single, poorly defined process anteriorly rather than two processes. The tibial apophysis is pronounced and hook-like. For further details regarding the palpus see Fig. 13.

Type Locality.—China: male holotype from Suifu, Szechwan Province. September, 1929, (D. C. Graham). *Type:* U.S.N.M. Cat. No. 1168.

This species is readily identifiable by the broad, transverse bands of white hairs on the chelicerae.

Family THOMISIDAE

Xysticus croceus, n. sp. Fig. 11

Xysticus ephippiatus Bösenberg and Strand. Abh. Senckenb. Naturf. Gesell. **30**: 261, pl. 10, fig. 161, 1906 (not *Xysticus ephippiatus* Simon).

Female.—Total length, 7.92 mm. Carapace, 3.36 mm long, 3.17 mm wide. Sternum, 1.56 mm long, 1.16 mm wide. Abdomen, 4.65 mm long, 4.55 mm wide. Carapace with a median longitudinal light band about one-third its width which encloses two reddish brown parallel lines that originate between the posterior median eyes and extend to the middle of the cephalothorax. Sides of the carapace reddish brown, interrupted by a light submarginal stripe on each side. Sternum yellow with reddish maculations, labium and endites concolorous with the sternum, maculations on the coxae more dense except for clear basal and median portions. Femora of the anterior legs heavily punctate with reddish brown, those of the posterior legs much lighter, with large red spots on the preaxial surfaces; nearly all the joints with reddish brown spots at their distal ends. Each leg bears above a more or less distinct light stripe extending its length. The abdomen, which is in poor condition, is reddish brown with thin indistinct stripes at the edges, the venter and sides are lighter.

Eye rows strongly recurved, the first narrower than the second (40/45). Ratio of eyes: ALE:AME:PLE:PME = 5.5:3:4:3. Anterior median eyes separated by more than three times their diameter, twice their diameter

from the laterals. Posterior median eyes removed from each other and from the posterior lateral eyes by more than three diameters. Median ocular area slightly wider than long (17/16), as wide in front as behind. Clypeus about two and one-half times the diameter of an anterior median eye.

Legs heavily spined; tibiae I with 2–1p–2–2–2–1p–2–2–2 spines of various sizes below; tibiae II with six pairs of spines below; metatarsi I and II with 2–2–1r–2–2–2 spines below. Legs, I, 9, 12 mm; II, 9.12 mm; III, 5.88 mm; IV, 6.36 mm.

Epigynum broader than long, transverse, the sides heavily chitinized. There is no chitinized portion extending caudad almost to the epigastric furrow.

Type locality.—China: Female holotype from Suifu, Szechwan province, 1922 (D. C. Graham). *Type:* U.S.N.M. Cat. No. 1169.

This species was regarded as *X. ephippiatus* Simon by Bösenberg and Strand, the differences in the epigyna and spinal armature being explained on the basis of injury and technique of handling. The discovery of a Chinese spider that corresponds closely with the description of Simon's species together with another that appears to be identical with that of Bösenberg and Strand makes it apparent that two species are involved. These two spiders, *X. croceus*, new species, and *X. ephippiatus* Simon differ greatly in the structure of the epigyna, and are readily distinguished by these characters alone. Below *X. ephippiatus* Simon is redescribed, and details regarding the two epigyna are shown in Figs. 3 and 11.

XYSTICUS EPHIPPIATUS Simon Fig. 3

Xysticus ephippiatus Simon. Ann. Soc. Ent. France **10** (Ser. 5): 107, pl. 3, fig. 6, 1880.

Female.—Total length, 9.40 mm. Carapace, 3.46 mm long, 3.46 mm wide. Sternum 1.36 mm long, 1.16 mm wide. Abdomen, 6.14 mm long, 6.44 wide. Carapace reddish with the characteristic median light band bearing three reddish streaks that originate between the posterior median eyes and extend to the thoracic groove. From the groove a reddish bar extends obliquely cephaled on each side. Sides of the carapace reddish with lighter submarginal stripes and darker marginal ones. Clypeus and chelicerae with robust black hairs of various size projecting forward. Sternum reddish brown, the labium, endites, and coxae much lighter being yellowish. Legs concolorous with the sternum, the posterior pairs lighter than the anterior, all the legs lighter below than above. Abdomen dark reddish brown above, venter somewhat lighter.

Eye rows recurved, the first narrower than the second (39/46). Ratio of the eyes ALE:AME:PLE:PME=6:3:4:3. Anterior median eyes removed from each other by more than three and one-half diameters, from the anterior lateral by two diameters. Eyes of the second row equidistant, separated by less than four times the diameter of a posterior median eye. Median ocular quadrangle wider than long (17/15), as wide in front as behind. Clypeus equal in height to about three times the diameter of an anterior median eye.

Legs heavily spined with the spinal armature irregular. The animal's right tibia I with 2–2–1p–2–2–2, right metatarsus I with 1p–2–2–1p–2–2–2 spines below, the animals left tibia I with 2–2–1p–2–2–2–2, left metatarsus I with 1p–2–2–2–2–2 spines below. Tibiae II with 2–2–2–2–2 spines below, right metatarsus II with 2–2–2–2–2–2, left metatarsus II with 1p–2–2–1p–2–2–2 spines below. Legs, I, 9.88 mm; II, 9.88 mm; III, 5.96 mm; IV, 6.20 mm.

Epigynum oval, with a chitinous extension extending caudad about half the distance to the epigastric furrow. For further details regarding the epigynum see Fig. 3.

Record.—China: Szechwan Province, Yao- Gi, Mupin, 8000 ft., July 14, 1929, female (D. C. Graham).

Xysticus sicus, n. sp. Fig. 5

Female.—Total length, 7.62 mm. Carapace, 2.67 mm long, 2.77 mm wide, 1.62 mm wide in front. Abdomen, 5.04 mm long, 4.95 mm wide. Carapace with a broad median whitish band beginning at the anterior median eyes, expanding to include the lateral eyes, narrowing behind them, and then expanding again making the anterior portion shield-like. Posteriorly the band gives off wings so that the caudal border of the carapace is provided with a broad submarginal stripe; at the junction of each lateral wing with the central band is a large black spot above and below. The cephalic portion of the band with a complex design consisting of a reddish lanceolate of dagger-shaped mark on a brownish shield-shaped background. Sides of the carapace reddish with white spots. Clypeus brown below the lateral eyes, but whitish below the median. Chelicerae tan with whitish spots basally, much lighter distally. Labium and endites reddish brown lighter at the centers. Sternum whitish, maculate with red. Legs white and reddish, with the reddish predominating, distal portion of the femora with noticeable black spots above. Abdomen whitish, densely provided with red spots and markings.

First row of eyes recurved, the median much closer to the lateral than to each other, about half as large as the lateral. The posterior row recurved, the median eyes nearer to each other than to the laterals, and about two-thirds as large. Anterior and posterior eyes on well developed tubercles. Median ocular quadrangle broader than long (15/12), slightly wider in front than behind, the eyes subequal. Clypeus much higher than the diameter of an anterior lateral eye (8/5).

Legs spinose, although there are absences due to injury the arrangement seems to be as follows: the first two tibiae armed below with five pairs of robust spines, the last two with three pairs of weak ones, the first two metatarsi with five pairs beneath, the last two with two pairs of spines of which one pair is apical. Legs I, 8.71 mm; II, 8.71 mm; III, 5.88 mm; IV, 7.15 mm. For the structure of the epigynum see Fig. 5.

Type locality.—China: female holotype from Mupin, Szechwan Province, 3500 ft., July, 1929. *Type:* U.S.N.M. Cat. No. 1170.

This species is closely allied to *Xysticus lateralis atrimaculatus* Bösenberg and Strand, but differs from that species in having the epigynum provided with a pair of heavily chitinized orifices that almost completely fill the basal half of the atrium.

Xysticus tunicatus Bösenberg and Strand

Xysticus tunicatus Bösenberg and Strand. Abh. Senckenb. Naturf. Ges. **30**: 263, pl. 10, fig. 176, 1906.

Record.—China: Szechwan Province, Summer, 1930, 3 females (D. C. Graham).

Xysticus saganus Bösenberg and Strand

Xysticus saganus Bösenberg and Strand. Abh. Senckenb. Naturf. Ges. **30**: 261 pl. 10, fig. 155, 1906.

Record.—China: Szechwan Province, between Kiating and Yachow, 1200 ft. July 29, 1929, male (D. C. Graham).

Thomisus transversus, n. sp. Fig. 8

Female.—Total length, 8.91 mm. Carapace, 3.86 mm at the widest place, 2.28 mm wide in front, 3.56 mm long. Abdomen, 6.04 mm long, 10.00 mm wide. Carapace reddish with a longitudinal median white band which diverges anteriorly giving off a thin stripe on each side of which is a semicircular mark. Sides of the carapace with indications of lighter stripes. Sternum, labium and endites yellowish brown. Legs concolorous with the sternum except for the tibiae of the posterior pairs which are dark brown contrasting strongly with the other joints. Abdomen yellowish white, darker at the anterior edges, with a dark median stripe. The five characteristic spots are present, one at the anterior edge of the dark median stripe and two on each side. Venter somewhat darker than the dorsum, bearing two longitudinal rows of three spots in the space between the epigastric furrow and the spinnerets.

First row of eyes recurved, narrower than the second row, which is also recurved, in the ratio of 5:6. Anterior median eyes two-thirds as large as the anterior lateral, and removed from each other by a distance elevenfifteenths as great as that which separates them from the anterior lateral. Posterior median eyes two-thirds as large as the posterior lateral, and removed from each other by a distance greater than that which separates them from the posterior lateral (24/15). Median ocular quadrangle wider than long (28/16), narrower in front than behind (17/28). Clypeus slightly less in height than the length of the median ocular quadrangle (13/16).

Legs sparsely spinose; tibia I with 1p–1p–1p–2–1p spines below, Tibiae II with 1p–2 spines below. Legs, I, 10.74 mm; II, 10.64 mm; III, 6.37 mm, IV, lacking.

Epigynum small, resembling that of *T. onustoides* Bösenberg and Strand, but differing in the possession of a narrower septum which arises at the caudal border rather than the anterior. For further details regarding the epigynum see Fig. 8.

Type locality.—China: female holotype from Shin kai Shi, Szechwan province, 4000 ft., July 6, 1934 (D. C. Graham). U.S.N.M. Cat. No. 1171

Thomisus onustoides Bösenberg and Strand

Thomisus onustoides Bösenberg and Strand Abh. Senckenb. Naturf. Ges. **30**: 251, pl. 10, fig. 166, 1906.

Record.—China: Szechwan Province, between Suifu and Kiating, June 2, 1930, male (D. C. Graham).

MISUMENA TRICUSPIDATA (Fab.)

Aranea tricuspidata Fabricius. *Systema entomologia*, p. 433, 1775.

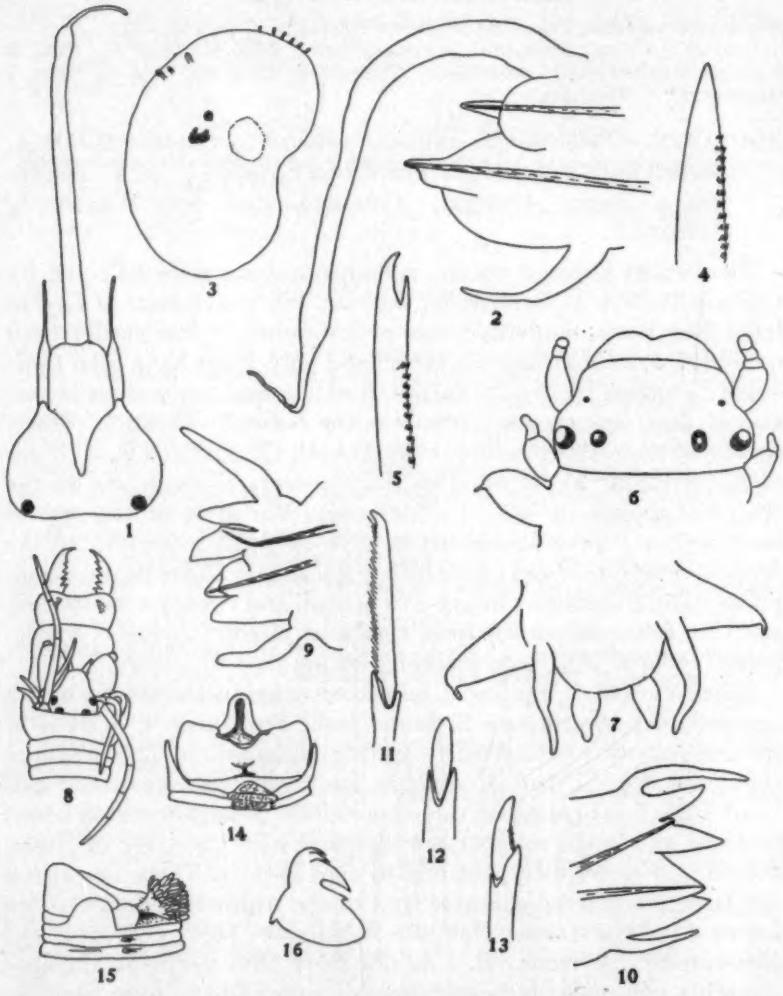
Records.—China: Szechwan Province, Suifu, 1000 ft. May 25, 1930, 2 females; October, 1930, one male; Chungking, 2000 ft., May 6, 1930, 2 females (D. C. Graham).

ZOOLOGY.—*Polychaetous annelids collected by Captain Robert A. Bartlett in Greenland, Fox Basin, and Labrador.*[1] A. L. TREADWELL, Vassar College. (Communicated by WALDO L. SCHMITT.)

This report is based on the polychaetous annelids collected by Captain Robert A. Bartlett on the east and west coasts of Greenland, Fox Basin, and the coast of Labrador. It has earlier been noted (Moore 1902) that the Greenland polychaets have been thoroughly studied by European investigators and, as was to be expected, few new species appear in the present collection. Many species of the regions visited occur on both the east and west shores of the Atlantic, as recorded in the elaborate monographs on the British Annelids by Wm. C. McIntosh. For most of the species listed below I have attempted to give only the references to the original description and to McIntosh's account. The collection comprises sixteen families, twenty-five genera, and twenty-nine species, of which four, *Harmothoe levis*, *Oophylax minuta*, *Nereis* (*Cerantonereis*) *bartletti* and *Pista groenlandica* are new to science.

Because of the presence of numerous setae in the stomach of a bearded seal, *Erignathus barbatus*, from Fox Basin a portion of the contents was submitted to me for examination. This material contained a good deal of what in land mammals we would call "hair balls," composed in this case chiefly of agglomerated setae. Of these the larger number are identical with the setae of *Eunoe nodosa* and undoubtedly belong to that species. There are also a few large black setae characteristic of the Aphroditacea, but I am uncertain of the species. Half of a *Nereis* jaw, badly corroded, was also noted in the material. I do not know that worms in the considerable quantities indicated by this sample have ever been reported as the food of marine animals before. The saved contents of the stomach of this seal totalled a full three-quarters of a gallon of similarly matted and setae-filled material, intermingled with one or two dozen gasteropod mollusk feet and operculae, several large shrimp, *Sclerocrangon boreas*, and the remains of perhaps six holothurians, *Cucumaria frondosa*, two to three inches long.

[1] Received October 16, 1936.



Figs. 1–5.—*Harmothoe levis*. 1, prostomium ×28. 2, parapodium ×35. 3, elytron ×12. 4, seta ×250. 5, seta ×250.

Figs. 6–7.—*Oophylax minuta*. 6, anterior end ×280. 7, posterior end ×280.

Figs. 8–13.—*Nereis (Ceratonereis) bartletti*. 8, anterior end ×10. 9, anterior parapodium ×100. 10, median parapodium ×100. 11, heterogomph neuroseta ×500. 12, posterior notoseta ×500. 13, posterior falcigerous neuroseta ×500.

Figs. 14–16.—*Pista groenlandica*. 14, ventral view anterior end ×7.5. 15, lateral view anterior end ×7.5. 16, uncinus ×250.

Family AMPHINOMIDAE

SPINTHER Johnston

SPINTHER CITRINUS (Stimpson)

Cryptonota citrina Stimpson 1854. p. 36.
Spinther citrinus Verrill 1873–74, p. 502.

A rare species. Stimpson's species came from Grand Manan, Verrill's from the Gulf of Maine, and the U. S. National Museum has some taken in the Bay of Fundy. The Bartlett specimen was taken at Fox Basin.

Family EUPHROSYNIDAE

EUPHROSYNE Savigny

EUPHROSYNE BOREALIS Oersted

Euphrosyne borealis Oersted 1843, p. 18, pl. 2, figs. 23–27.

A fairly common species in the region covered by the collections. It was recorded by Wesenberg-Lund (1934, p. 24) as a new record for East Greenland. In the Bartlett collection it was taken at E. end of Cobourg Id., Baffin Bay, 75°40′N., 78°50′W., Aug. 1935.

Family POLYNOIDAE

GATTYANA McIntosh

(*Nychia* Malmgren name preoc.)

GATTYANA CIRROSA (Pallas)

Aphrodita cirrosa Pallas 1766, p. 95, pl. 8, figs. 3–6 (teste McIntosh).
Nychia cirrosa Malmgren 1865, p. 58, fig. 1.
Gattyana cirrosa McIntosh 1900, pp. 285–291, pl. 25, fig. 3; pl. 27, fig. 5; pl. 31, fig. 1; pl. 37, figs. 16–19; pl. 42, fig. 27.

Collected S. of Cape Martineau, Melville Peninsula, Aug. 9, 1933; Fox Basin (N & B) 1933; E. end of Cobourg Id., Baffin Bay, 75° 41′N., 78° 20′W., Aug. 3, 1935; Murchison Sd., N. Greenland, Aug. 20, 1926.

EVARNELLA Chamberlin

(*Evarne* Malmgren name preoc.)

EVARNELLA IMPAR (Johnston)

Polynoe impar Johnston 1839, p. 463, pl. 22, figs. 3–9 (teste McIntosh).
Evarne impar McIntosh 1900, pp. 353–358; pl. 27, fig. 13; pl. 30. fig. 7; pl. 32, fig. 18; pl. 39, figs. 20–22.

Collected E. end of Cobourg Id., Baffin Bay, 75° 40′N., 78° 50′W., Aug. 3 and 4, 1935; 4 mi. east of Cape Dorchester, Fox Channel, Aug. 4, 1927; 3 mi. S. from Salisbury Id., Hudson Strait (N & B)[2] July 25, 1933; Duckett Cove, Hurd Channel, Aug. 11, 1933; between Hurd Channel and Melville Peninsula, Aug. 7, 1933; S. of Cape Martineau, Melville Peninsula, Aug. 9, 1933; 66° 30′N., 80°W., Aug. 10, 1927.

[2] Norcross-Bartlett Expedition, 1933.

Harmothoe Kinberg

Harmothoe imbricata (Linnaeus)

Aphrodita imbricata Linnaeus 1766, p. 1084 (teste McIntosh).

Harmothoe imbricata Malmgren 1865, p. 66, pl. 9, fig. 8; McIntosh 1900, pp. 314–327, text figs. 25–30; pl. 25, fig. 6; pl. 30, fig. 1; pl. 32, fig. 10; pl. 38, figs. 14–16; pl. 26a, figs. 1, 3–8, 12.

A very widely distributed species showing a considerable degree of variability. Collected at Bight, Shannon Id., N.E. Greenland, July 29, 1930; N. Omenolu, North Star Bay, N. Greenland, July 28, 1932; Cape Alexander, Smith Sound, N. Greenland, Aug. 26, 1932; Cape York, N. Greenland, in dredge "between glacier and bill of Cape," 76° 50′N., July 21, 1926; Cape York, N. Greenland, 76° 0′N., July 21, 1926; Parker Snow Bay, N. Greenland, July 17, 1935; S. part of Fox Basin, 66° 43′N., 80° 07′W., Aug. 27, 1927; 3 mi. from Southampton Id., Hudson Strait, July 31, 1933; Sturges Bourne Strait, W. end of Hurd Channel, Melville Peninsula (N & B), Aug. 18, 1933; Duckett's Cove, Melville Peninsula, Aug. 11, 1933; N.E. end of Melville Peninsula, entrance to Fury and Hecla Straits, Aug. 5, 1933 (N & B); N.E. of Cape Dorchester, Fox Channel, Aug. 4, 1927; between Hurd Channel and Melville Peninsula, Aug. 7, 1933; E. end of Cobourg Id., Baffin Bay, 75° 40′N., 78° 50′ and 45′W., Aug. 3 and 4, 1935; Cove, N. shore of Lyon Inlet, Melville Peninsula (N & B), Aug. 24 and 25, 1933; S. of Cape Martineau, Melville Peninsula, Aug. 9, 1933; 66° 30′N., 80°W., Aug. 10, 1927; Labrador, no year given; Saglek Bay, Labrador, Sept. 25, 1925; Coast of Labrador, summer 1925.

Harmothoe levis n. sp.

The type specimen is 15 mm long and, measured from the outer borders of the elytra on opposite sides, 5 mm wide. The elytra overlap on the dorsal surface and extend laterally so as to cover the basal third of the dorsal cirri. In the type the protruded pharynx is 4 mm long. Under low magnification the elytra have a smooth appearance, tinted faintly-pinkish gray, each being marked near the center (fig. 3) by a group of brown pigment granules. To the naked eye this smooth surface with the prominent pigment is the most characteristic feature of the animal. In the type the pigment is present on all elytra, smallest anteriorly and gradually increasing in size in the following ones. In others the color may be absent in the most anterior elytra.

The prostomium is characteristic of the genus in that each half terminates anteriorly in a peak beneath which, and invisible from above, are the large anterior eyes. The posterior eyes are also large and lie near the posterolateral angle of the prostomium. The cirrophore of the median tentacle is large and fills the dorso-median prostomial cleft. Its length is about equal to that of the prostomium (fig. 1). The median tentacular style is about two and one half times as long as the cirrophore, very faintly swollen near the tip, and terminates in a slender filament. The prostomium is colored like the elytra, the cirrophore of the median tentacle is a darker brown, the basal half of the style is colored like the cirrophore, beyond this there is a lighter area, then a darker one of about the same length, then the slight swelling which is colorless. At the base of the filament is a dark spot, the remainder being colorless. The lateral tentacles are scarcely longer than the cirrophore of the median and are colored like it. Their slender apical regions are about as long as the stouter basal portions. The palps are of moderate size and

taper uniformly to their apices, their general coloration being like that of the median tentacle, the apices white. The tenacular and dorsal cirri are like the median tentacle in form and color but in general are somewhat smaller. The last three pairs of dorsal cirri are very long. Anal cirri had been lost.

The protruded pharynx has dorsally ten and ventrally nine soft marginal papillae. The teeth are very sharp pointed and light-brown in color with darker margins.

The first two pairs of elytra are nearly circular in outline, the others kidney-shaped (fig. 3). The pigment patch is located postero-dorsally to the elytrophore scar. Except for a very few clavate cilia on the posterior border, the margin is smooth. Near the outer lateral margin are a few larger stout spines and the whole surface is densely studded with minute spines not shown in the figure.

A parapodium from the middle of the body (fig. 2), has a very long dorsal cirrus, both dorsal and ventral cirri lying near the posterior parapodial border, while the notopodial lobe is a little anterior to the neuropodial. The notopodium is composed of a broadly rounded anterior and a very narrow sharp-pointed posterior lip, with a fan-shaped row of heavy setae arising between them. The acicula extends into the posterior lip. The neuropodium is considerably longer and larger than the notopodium. It has a rounded posterior lip, posterior to which the setae arise. The anterior lip is almost rectangular in outline but has a narrow dorsal prolongation into which the acicula extends.

The notopodial setae vary in size, the one at the ventral end of the series being hardly one-half as wide or one-eighth as long as the dorsalmost one. They are all (fig. 4) heavy, blunt-pointed, and have rows of toothed plates extending nearly to the ends. The neuropodial setae have long slender stalks widened toward the outer ends. Distally they gradually narrow again so that the apices are about half as wide as the narrowest portion of the stalk. Each (fig. 5) terminates in a terminal hook and a subterminal tooth. Toothed plates extend nearly to the base of the tooth.

The type, No. 20222 U.S.N.M., was taken at Angmagssalik, E. Greenland, on Aug. 31, 1931. Another specimen was secured between Capes Martineau and McLaren, at the south end of Melville Peninsula on Aug. 19, 1933, and a third at 66° 30′ N., 80° W., Aug. 27, 1927.

This species is closely related to *Harmothoe imbricata* Linn.

EUNOE Malmgren

EUNOE NODOSA (Sars)

Polynoe nodosa Sars 1860, p. 59.

Eunoe nodosa Malmgren 1865, p. 64, pl. 8, fig. 4; McIntosh 1900, pp. 291–296, pl. 27, fig. 9; pl. 32, fig. 3; pl. 37, figs. 20, 22, 24, 26, 27; pl. 42, fig. 28.

Collected at Clavering Fiord, N.E. Greenland, Aug. 2, 1930; 66° 30′N., 80° W., Aug. 10, 1927; Fox Basin, Aug. 26, 1927; Center of Fox Basin, Aug. 24 and 25, 1927; S. part of Fox Basin, 66° 43′ N., 80° 07′ W., Aug. 12, 1927; coast of Labrador, Sept.–Oct. 1925; Fox Basin (N & B), 1933.

EUNOE OERSTEDI Malmgren

Eunoe oerstedi Malmgren 1865, pl. 8, fig. 3.

A species related to *E. nodosa* and considered by Fauvel (1914, p. 51) as synonymous with it. One important distinction in the specimens in the Bartlett collection is that *E. oerstedi* has very prominent spines on the elytra which are not found in *E. nodosa*.

Collected at Cape Alexander, Smith Sound, N. Greenland, Aug. 26, 1932; Hurd Channel between Bushman Id. and Melville Peninsula, Aug. 17, 1933; S. end of Cobourg Id., Baffin Bay, 75° 40′N., 78° 58′W., Aug. 4, 1935; 66° 36′N., 78° 58′W., Aug. 10, 1927.

Family NEPHTHYDIDAE

Nephthys Cuvier

Nephthys ciliata (Müller)

Nereis ciliata Müller 1789, p. 114, pl. 89, figs. 1–4 (teste McIntosh); Malmgren 1865, p. 104, pl. 12, fig. 17; McIntosh 1908, pp. 24–27, pl. 66, fig. 9; pl. 77, figs. 6, 7.

Collected between Capes Martineau and McLaren, S. end of Melville Peninsula, Aug. 19, 1933; Duckett's Cove, Hurd Channel, Aug. 11, 1933; King Francis Joseph Fiord, N.E. Greenland, Aug. 4, 1936; North Fiord, N.E. Greenland, Aug. 2, 1936.

Family PHYLLODOCIDAE

Phyllodoce Savigny

Phyllodoce groenlandica Oersted

Phyllodoce groenlandica Oersted 1842–43, p. 121 (teste McIntosh); McIntosh 1908, pp. 86–88, pl. 58, fig. 5; pl. 68, figs. 4, 5, 6; pl. 78, fig. 7.

Collected at Clavering Fiord, N.W. Greenland, July 29, 1930; Disco Id., July 17, 1935 (this specimen is badly macerated and is recorded as taken from a cod's stomach); at entrance to Straits of Fury and Hecla, Sept. 3, 1933. One bottle, marked simply "Labrador" contained a much injured specimen too badly broken for identification. It possibly is of this species.

Family SYLLIDAE

Syllis Savigny

Syllis armillaris (Müller)

Nereis armillaris Müller 1776, p. 217 (teste McIntosh).

Syllis armillaris Oersted 1842–43, p. 118 (teste McIntosh); McIntosh 1908, pp. 188–191, pl. 60, fig. 1; pl. 70, fig. 14; pl. 80 (1910), figs. 8, 8a.

Collected at 70° 04′N., 17° 58′W. (N & B); 66° 30′N., 80°W.; and at S. part of Fox Basin, 66° 43′N., 80° 07′W., Aug. 12, 1927.

Polybostrichus Oersted

Polybostrichus (Autolytus) longosetosus Oersted

Polybostrichus longosetosus Oersted 1843, p. 183, pl. 5, figs. 62, 67, 71 (teste Quatrefages).

Collected at S. part of Fox Basin, 66° 43′ N., 80° 10′ W., Aug. 27, 1927.

OOPHYLAX Ehlers

Oophylax minuta n. sp.

The type and only specimen is very small, hardly 2 mm in length. It was found clinging to another annelid, but this association evidently was accidental. The prostomium has a width of nearly twice its length (fig. 6), and near its posterior border are four large eyes, the lateral ones being slightly the larger. The lenses of the median eyes are directed dorsally, those of the lateral ones dorso-laterally. Anterior to these on either side is a much smaller eye. The palps are short and are fused nearly to their ends, this fusion being more complete dorsally than ventrally. Focussing below the level shown in the figure shows a definite cleft between them. The tentacles are heavy, each having a swollen basal portion which abruptly narrows into a cylindrical terminal region, the latter ringed in such a way as to resemble articulations.

The first somite is rather short and has on either side a tentacular cirrus which is slightly smaller than the tentacle but is otherwise similar to it in shape. There are twenty-five pairs of parapodia, all prominent, the first one rounded in outline but later ones become gradually more sharp pointed toward the ends. In anterior somites the dorsal cirri are larger than the tentacular but similar to them in form. Beginning at about the sixth parapodium, these begin to narrow toward their bases and throughout the greater part of the body they are cylindrical and extend beyond the ends of the parapodia. There is one pair of short, thick, anal cirri (fig. 7). I was unable to see clearly the anterior ventral cirri but posterior ones are slender and cylindrical and reach about half way to the ends of the parapodia. The parapodia are conical, each having at its apex a small, colorless, posteriorly directed cirrus (see figs. 6, 7). The setae are all compound and prominent, the largest reaching beyond the parapodium to a distance equal to the length of the latter. The basal joint is slender, expanding noticeably at the heterogomph outer end. There are two kinds of terminal joints in each somite differing from one another only in length. Their ends are curved to sharp hooks. I was unable to decide whether their concave margins are merely roughened or carry excessively minute hairs. The pharynx has anteriorly a single median tooth and extends as far as the posterior border of the third setigerous somite. The crop extends through four somites.

The unique type, No. 20223 U.S.N.M., was collected four miles east of Cape Dorchester in Fox Channel on Aug. 4, 1927.

Oophylax is diagnosed by Ehlers (1864, p. 252) as having "four paired head appendages and eyes, palps more or less fused, seta-bearing parapodium of the first somite similar to later ones." Chamberlin (1919, pp. 166, 167) stated that *Oophylax*, with some other genera, is synonymous with *Exogone*, which he defined (p. 165) as having palps completely fused and rudimentary tentacular cirri, with all tentacles and cirri cylindrical. The specimen agrees more closely with Ehlers' than with Chamberlin's diagnosis and I have therefore described it as *Oophylax*.

Family NEREIDAE

NEREIS Linnaeus

NEREIS PELAGICA Linnaeus

Nereis pelagica Linnaeus 1746, p. 2096; McIntosh 1910, pp. 267–280, pl. 52, figs. 1, 2; p. 160 (1908), figs. 6–6b; pl. 71, figs. 7–7i; pl. 80, figs. 25, 25b.

A very widely distributed species but no great number of specimens appeared in the Bartlett collections. Collected at 63° 16′ 09″ N., 84° 21′ 15″ W., Aug. 1, 1933; 3 mi. S. of Salisbury Id. (N & B), July 27, 1933; mouth of Bay of Gods Mercy, Southampton Id., Hudson Bay (N & B), Aug. 5, 1933; a much mutilated specimen in epitokous condition was taken at Duckett's Cove, Melville Peninsula, Aug. 13, 1933; Coast of Labrador, 1925; 74° 04′ N., 17° 58′ W. (N & B), July 30, 1931.

Nereis arctica Oersted

Heteronereis arctica Oersted 1843, p. 179. pl. 4, figs. 50, 51; pl. 5, figs. 65, 68, 69–70* (teste Quatrefages).

Collected at S.E. corner of Fox Basin, 66° 46′ N., 79° 15′ W., Aug. 13,1927.

Nereis (Ceratonereis) Kinberg

Nereis (Ceratonereis) bartletti,[3] n. sp.

The type and only specimen is 28 mm long and 0.75 mm wide at the prostomium. The prostomium is colorless. On the peristomium is a faint dusting of brown pigment which becomes slightly more intense in the following somites and noticeably so on the region from the sixth to the thirtieth, being densest from the fifteenth to the twentieth. Behind the thirtieth this pigmentation continues in a gradually decreasing intensity to nearly the posterior end of the body. Except where it is more intense it is limited to a transverse dorsal band in each somite as long as one half the dorsal body-diameter and leaving uncolored the intermediate regions. In more deeply pigmented somites there are lateral patches on the parapodial bases separated from the dorsal ones by a distinct colorless line.

The prostomial length is about equal to its breadth (fig. 8), rather broadly rounded on the anterior border. The tenacles are relatively rather heavy and are well separated from one another. The basal joints of the palps are heavy and extend well beyond the tentacle ends, the terminal joints being mere knobs. Two pairs of prominent eyes are situated well toward the posterior border. In the preserved specimen the posterior eyes are about one half covered by the overlapping margin of the peristomium. The posterior dorsal tentacular cirrus reaches to the anterior border of the seventh somite, the anterior dorsal to the anterior border of the fourth, the ventral ones are hardly longer than the prostomium. The dorsal ones are more slender than the ventral and show a small amount of jointing. All dorsal cirri are slender, unjointed, and not especially long. The two anal cirri are as long as the last ten body somites.

In the protruded state of the pharynx the peristomium is much wider than the prostomium. In the mid-dorsal line it is about twice as long as somite 2. The following somites increase in length and width as far as the region of the twentieth, while posterior to that they gradually decrease toward the posterior end.

The protruded pharynx (fig. 8) has large teeth, each with a terminal fang and five heavy denticulations. The paragnath formula is I, absent; II, not more than ten, in two rows, the larger lying on the inner row; III, a few obscure denticles rather widely separated; IV, on either side a roughly triangular patch whose apex extends as two rows nearly to the bases of the jaws; V, VI, VII and VIII absent.

[3] In honor of the discoverer, Capt. R. A. Bartlett.

Anterior parapodia (fig. 9) have a heavy dorsal cirrus extending for about one-third its length beyond the end of the dorsal lobe. This dorsal lobe is an elongated oval in outline, its outer half only slightly narrower than its inner. The setal lobe is a small elevation on the dorsal surface of the ventral lip and the acicula ends in it. The ventral lip of the notopodium is roughly triangular in outline, its base extending beyond the end of the dorsal lobe. In the neuropodium the setal lobe has a vertical posterior and a conical anterior lip, the large acicula ending in the latter. The ventral lip is heavy and shorter than the setal lobe. A parapodium from the middle of the body (fig. 10) has much the same structure as the anterior ones, except that the lobes are more pointed. This general structure persists posteriorly, the only change being that the lobes become still more pointed.

In anterior parapodia there are few notopodial setae (three in the parapodium drawn, fig. 9), each having a very slender homogomph basal portion, the terminal joint long and slender and finely toothed along one margin. The neuropodial setae are in two tufts, one above and one below the acicula. In each tuft are two kinds of setae, one form being like those of the notopodium, the other having heterogomph basal joints, the terminal joint a flattened blade that narrows regularly from base to apex which is rounded and slightly curved. Along one margin is a row of bristles (fig. 11). On the second and third parapodia in front of the pygidium are setae not found farther forward. On the specimen examined there is in the notopodium one shown in figure 12. This has homogomph basal joint. The terminal joint is elongated-oval in outline, one end being inserted in the notch at the end of the basal. In the neuropodium are two like figure 13. The basal joint is heterogomph, the terminal short and thick, curved slightly and has a row of bristles for about half its concave margin. Both of these forms of setae are much larger than any in anterior somites and have much darker basal joints.

Type, No. 20224, U.S.N.M., was taken in a dredge at 129 fathoms at 74° 04′ N., 17° 58′ W., on July 30, 1931.

Family LEODICIDAE

LUMBRINEREIS Blainville

LUMBRINEREIS FRAGILIS (Müller)

Lumbricus fragilis Müller 1788, p. 22, pl. 22, figs. 1–3.

Lumbriconereis fragilis Audouin et Edwards 1833, vol. 28, p. 244; McIntosh 1910, pp. 372–376, pl. 62, figs. 1, 1a; pl. 72, figs. 8–8c; pl. 82, figs. 2–2b.

All of the specimens in the collection were badly macerated and the identification was made mostly through the structure of the jaws.

Collected in summer of 1925, coast of Labrador; Saglek Bay, Labrador, Oct. 1, 1925; Coast of Labrador, Sept.–Oct. 1925.

ONUPHIS Audouin et Edwards

ONUPHIS CONCHYLEGA Sars

Onuphis conchylega Sars 1835, p. 61, pl. 10, figs. 28 a–e; McIntosh 1910, pp. 410–413, pl. 63, fig. 9; pl. 64, figs. 1–1a; pl. 75, fig. 7; pl. 84, figs. 5–5c.

In the identification I have followed McIntosh's description. The only differences I could find are that the frontal tentacles are more prominent and the nuchal cirri longer than in his statement. There is much variation

in the coloration from practically no color at all to a dense brown dorsal pigmentation.

Collected at 74° 04′ N., 17° 58′ W., July 30, 1931 (N & B); 74° 21′ N., 16° 30′ W., July 29, 1931; E. end of Cobourg Id., Baffin Bay, 75° 40′ N., 78° 50′ W., Aug. 3, 1935; 75° 40′ N., 78° 55′ W., Aug. 3, 1935.

Family GLYCERIDAE

Glycera Savigny

Glycera lapidum de Quatrefages

Glycera lapidum de Quatrefages 1865, pp. 187, 188; McIntosh 1910, pp. 477–481, pl. 55, fig. 4; pl. 64, figs. 9–9a; pl. 76, figs. 1–1b; pl. 85, figs. 3–3b.

Collected at S. end of Cobourg Id., Baffin Bay, 75° 40′ N., 78° 58′ W., Aug. 4, 1935.

Family OPHELIDAE

Ophelia Savigny

Ophelia limacina Rathke

Ophelia limacina Rathke 1843, p. 190, pl. 10, figs. 4–8 (teste McIntosh); McIntosh 1915, pp. 9–14; pl. 88, fig. 1; pl. 95, figs. 1, 1d.

Collected at Hakluyt Id., Whale Sound, 77° 26′ N., 72° 30′ W., July 30, 1935; E. end Cobourg Id., Baffin Bay, 75° 40′ N., 78° 56′ W., Aug. 4, 1935; and at latter locality but at 58′ W. on Aug. 4, 1935.

Family CHLORHAEMIDAE

Brada Stimpson

Brada granosa Stimpson

Brada granosa Stimpson 1854, p. 32.

E. end Cobourg Id., Baffin Bay, 75° 40′ N., 78° 50′ W., Aug. 3, 1935; King Francis Joseph Fiord, N.E. Greenland, Aug. 4, 1936.

Family AMPHICTENIDAE

Pectinaria Lamarck

Pectinaria granulata (Linnaeus)

Sabella granulata Linnaeus 1766, p. 1268.

Cistenides granulata Malmgren 1865, p. 359.

Collected at Angmagssalik, E. Greenland, Aug. 28, 1931; Parker Snow Bay, off Cape York, July 17, 1935; N. Omenolu, near North Star Bay, N. Greenland, July 28, 1932; Cape York, N. Greenland, Aug. 28, 1932; 5 mi. S. of Cape Chalon, N. Greenland, July 27, 1932; between Capes Martineau and McLaren, Aug. 19, 1933; cove N. shore Lyon Inlet, Melville Peninsula, Aug. 24 and 25, 1933; Duckett's Cove, Hurd Channel, Aug. 11 and 12, 1933; Hurd Channel, between Bushman Id. and Melville Peninsula, Aug. 17, 1933; S. of Cape Martineau, Melville Peninsula, Aug. 19, 1933; King Francis Joseph Fiord, N.E. Greenland, Aug. 4, 1936.

Family AMPHARETIDAE

AMPHARETE Malmgren

AMPHARETE GROENLANDICA Grube?

Ampharete groenlandica Grube 1860, vol. 26, pp. 106–107, pl. 5, figs. 3, 3a, 3b.

A single female with eggs. All of the tentacles have been lost and I have provisionally identified it as above.

Collected at 66° 30′ N., 80° W., Aug. 27, 1927.

Family TEREBELLIDAE

THELEPUS Leuckart

THELEPUS CINCINNATUS (Fabricius)

Amphitrite cincinnata Fabricius 1780, p. 286.

Thelepus cincinnata Malmgren 1865, p. 387, pl. 22, fig. 58.

Thelepus cincinnatus Verrill 1874, vol. 7, p. 499; McIntosh 1922, pp. 170–177, pl. 120, fig. 1; pl. 126, figs. 6–6d (var. *andreneae*).

Abundant in the collections associated with *Pista groenlandica*. The tubes differ from those of *P. groenlandica* in that *Thelepus* uses larger and a more heterogeneous collection of pebbles to cover the surface than does *Pista*.

Collected at 74° 04′ N., 17° 58′ W. (N & B), July 30, 1931; 74° 21′ N., 16° 30′ W. (N & B), July 29, 1931; North Omenolu, North Star Bay, N. Greenland, Aug. 26, 1932; 5 mi. S. from Cape Charles, N. Greenland, July 27, 1932; E. end of Cobourg Id., Baffin Bay, 75° 40′ N., 78° 40′ W., Aug. 3, 1935; at entrance to Strait of Fury and Hecla, Sept. 3, 1933; 3 mi. S. from Salisbury Id. (N & B), Hudson Strait, July 25, 1933; cove to windward of Cape Charles, W. side of Lyon Inlet, Melville Peninsula, Aug. 18, 1933; between Capes Martineau and McLaren, S. end of Melville Peninsula, Aug. 19, 1933; S. of Cape Martineau, Melville Peninsula, Aug. 19, 1933; 66° 30′ N., 80′ W., Aug. 10, 1927.

PISTA Malmgren

PISTA FLEXUOSA (Grube)

Terebella flexuosa Grube 1860, vol. 26, pp. 102–103, pl. 5, figs. 2 and 2a.

Scione flexuosa Wesenberg-Lund 1934, p. 29.

The arrangement of the gills puts this species in the genus *Pista*.

Collected at E. end of Cobourg Id., Baffin Bay, 75° 40′ N., 78° 58′ W., Aug. 3, 1935.

Pista groenlandica n. sp.

Common in the collection in association with the commoner *Thelepus cincinnatus* Fabricius. Their tubes may be distinguished by the fact that they are somewhat smaller than are those of the latter species and the surfaces of the tubes are covered with sand grains which are smaller and more uniform in size than is the case with *T. cincinnatus*.

The type is 70 mm long and has a prostomial width of 3 mm. So far as can be determined on preserved material the body width is fairly uniform throughout except that there is a noticeable narrowing at the posterior end.

The cephalic margin is not very pronounced and on its latero-ventral side is largely covered by a large latero-ventral lobe of the first somite. Ventrally it is separated by a notch from the high and rather narrow supraoral fold. None of the specimens had been preserved outside of the tube and it was found quite impossible to remove them from the tubes without injuring the tentacles and only a few of these remain on the type. They occur in a dense tuft and when contracted show grooving. No eyes were visible. Dorsally the first somite is very short, its two halves separated in the mid-dorsal line by a forward expansion of the second somite that carries the gills. A prominent lateral lobe is present on either side of the first somite. Ventrally the two lobes are united by a transverse bridge (fig. 14), and posterior to this each lobe sends out a rounded process, the two nearly meeting in the mid-ventral line. The second somite is very short on the mid-ventral line but widens laterally and is continued dorsally as a larger area carrying the gills. The third somite carries ventrally the first shield which extends over the second somite and is divided into two by a transverse line. Laterally the third somite carries a free lobe which extends forward nearly as far as the anterior border of the first somite (fig. 15). There is one pair of gills situated on the dorsal surface of the second somite. Each (fig. 15) has a heavy base and divides into five (in the one figured) branches which subdivide toward the ends. There is no indication of a spiral arrangement such as has been described in other species of this genus.

On the type are twelve well defined ventral shields and behind them a row of very much smaller ones that at about the twentieth somite fade away into a deep groove. A row of ten cirri, of which the two ventral ones are the largest, surround the anus.

The first seta tuft is on the fourth somite and there are sixteen pairs. The setigerous ridges increase in size from anterior to posterior ones, the later ones being prominent. The uncini begin on the fifth somite, the tori being very low as far as the setae extend and behind this they protrude considerably from the body. They continue to the posterior end of the body, the latest ones being smaller. The setae are all long and slender, very fine-pointed, and gently curved at the ends. They are bilimbate, the wings being noticeably striated. An uncinus (fig. 16) has a broadly rounded base and one large hook. At the apex there is a much smaller hook and on either side one larger than the apical one. A hook-like projection lies between the uncinal base and the largest hook. In anterior tori the uncini are in single rows but at about the tenth the rows become double with alternate uncini facing in opposite directions.

The type, No. 20225, U.S.N.M., and a paratype deposited in the American Museum of Natural History were collected at the east side of Cobourg Id., Baffin Bay, 75° 40′ N., 78° 40′ W., Aug. 3, 1935. Others were taken 5 miles S. of Cape Charles; at entrance to Straits of Fury and Hecla; at Duckett's Cove, Hurd Channel; at 74° 04′ N., 17° 58′ W.; and at 74° 21′ N., 16° 30′ W.

Pista cristata O. F. Müller appears in a number of lists of polychaetous annelids collected from the northeastern coast of North America and McIntosh (1922, p. 160) lists the species from Canada (Whiteaves), New England and Atlantic coast (Verrill), and Virginia (Webster). In his diagnosis of the species, McIntosh (p. 158) states that the gills arise from the anterior border of the fourth somite, but later (p. 161) he locates them on the third. In *P. groenlandica* they are on the third. Other differences are that in *P. cristata* there are three pairs of lateral lobes on the second, third, and fourth somites, respectively, while *P. groenlandica* has only one pair on

the second. The arrangement of anal papillae is quite different, as is the structure of the uncini. Verrill (1882, pl. 11, fig. 2) figures *P. cristata*, but his figure seems to correspond more closely to *P. groenlandica*, and McIntosh does not record any personal observations on any American forms, basing his descriptions solely on the European. It seems to me quite possible that the ones described from North America are *P. groenlandica*. I cannot find that the papers show anything more than a relisting of the species without any critical examination. The relationship between the two species is close.

TEREBELLIDES Sars

TEREBELLIDES STROEMI Sars

Terebellides stroemi Sars 1835, p. 48, pl. 13, fig. 31 (teste McIntosh); McIntosh 1922, pp. 209–215, pl. 127, figs. 5, 5′, 5″, 5a, 5a′, 5b.

A single entire specimen which agrees in all respects with the description given by McIntosh, except that it has only one pair of gills on the second somite, while McIntosh describes two pairs on somites 2 and 3. His figure, however (pl. 120, fig. 3), shows only one pair.

Collected at Cove, N. shore of Lyon Inlet, Melville Peninsula, Aug. 24, 1933.

Family SABELLIDAE

CHONE Kroyer

CHONE DUNERI Malmgren

Chone duneri Malmgren 1867, p. 116, pl. 13, fig. 75; McIntosh 1923, pp. 295–297, pl. 130, figs. 3–3c.

Distinguished from *C. infundibuliformis*, which is much commoner in this region, by the fact that in *C. duneri* the thoracic spatulate setae have long sharp points, while in *C. infundibuliformis* they have rounded ends.

Collected at E. end of Cobourg Id., Baffin Bay, 75° 40′ N., 78° 40′ W., Aug. 3, 1935.

Family SERPULIDAE

SPIRORBIS Daudin

SPIRORBIS SPIRILLUM (Lamarck)

Serpula spirillum Linnaeus 1758, p. 786.

Spirorbis spirillum Lamarck 1818, p. 359; McIntosh 1923, pp. 391–396, pl. 122, figs. 9–9b; pl. 132, figs. 6–6f.

Collected in considerable numbers on floating sea weed at mouth of Bay of Gods Mercy, Southampton Id., Hudson Bay, Aug. 5, 1933 (N & B).

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ZOOLOGY.—*Resistance to intestinal trichinosis in experimental animals induced by feeding metabolic products of encysted trichinae.*[1]

L. A. SPINDLER, Bureau of Animal Industry, U. S. Department of Agriculture (Communicated by BENJAMIN SCHWARTZ).

Administration of vaccines by mouth has been found to be of value in some cases in the treatment of certain diseases, and in view of this, it occurred to the writer that metabolic products elaborated by trichina larvae might be used in a similar manner to produce a resistance to intestinal infestation with this parasite. Attempted immunization by injection of trichina proteins has yielded negative results.[2] In order to determine, therefore, whether the ingestion of metabolic products of trichina larvae would pro-

[1] Received October 7, 1936.
[2] McCoy, O. R. Amer. Jour. Hyg. **21**: 200. 1935.

tect animals against infection with this parasite, carcasses of rabbits containing encysted trichinae were digested in artificial gastric juice thus liberating into the digestive fluid possible metabolic products of the larvae present within the capsules.

The digestive fluid was prepared and the digestive process carried out as outlined by Ransom.[3] The fluid obtained following the digestion of trichinous meat was filtered through a Mandler filter to remove all trichina larvae and coarse undigested particles; be-

TABLE 1.—RESULTS OF FEEDING METABOLIC PRODUCTS OF ENCYSTED TRICHINAE

Test No.	No. of animals used	No. of trichinae given per animal	Neutralized digestive fluid per animal (cc)		Days duration of infection	Average No. of trichinae per animal		Percentage of trichinae in test animals as compared to controls
	test and control	test and control	test	control	test and control	test	control	
1	4 rats	1,850	8 to 12	0	3	663	1,100	60.3
2	4 rats	5,200	10 to 15	0	3	3,910	4,630	84.4
3	4 rats	10,150	6 to 8	0	6	3,560	4,950	71.9
4	4 rats	10,000	50 to 70	0	4	1,750	3,300	53.0
5	4 rats	500	140 to 200	0	3	128	400	32.0
5a	2 rats	500	95 to 100[1]	0	3	170	398	42.7
5b	2 rats	500	90 to 110[2]	0	3	395	400	98.8
6	2 rabbits	25,000	110 to 125	0	6	5,075	12,950	39.1
7	2 rabbits	26,375	65 to 80	0	4	7,470	18,522	40.3
8	2 rabbits[3]	4,000	30 to 60	0	3	200	1,200	16.6
8a	2 rabbits[3]	4,000	30 to 60	0	3	187		15.6
9	4 guinea pigs[4]	555	100 to 125	0	3	220		55.0
9a	4 guinea pigs[4]	555	120 to 130	0	3	175	400	43.8
9b	4 guinea pigs[4]	555	115 to 145	0	3	400		100.0
10	3 guinea pigs[5]	800	60 to 80	0	3	325	600	54.2
10a	3 guinea pigs[5]	800	50 to 85	0	3	563		93.8

[1] Digestive fluid heated before feeding.
[2] Fluid obtained after artificial digestion of carcass of trichina-free rabbit.
[3] Two control rabbits were used in these tests.
[4] Four control guinea pigs were used in these tests.
[5] Three control guinea pigs were used in these tests.

fore administering the fluid, it was neutralized with decinormal sodium hydroxide, using phenolphthalein as an indicator. Rats, rabbits and guinea pigs were the host animals used in the experiments.

Both test and control animals were infected with equal numbers of trichina larvae, and the test animals were given the neutralized digestive fluid by mouth throughout the duration of the experiment; the control animals received distilled water instead of the digestive fluid.

A post-mortem comparison, made 3 to 6 days after infection, of the number of adult trichinae in the test animals with those present

[3] Ransom, B. H. Jour. Agric. Res. 5: 819. 1916.

in the controls was the criterion for determining whether or not a resistance had been brought about by ingestion of the digestive fluid. The technic involved in these examinations was the same as that outlined by McCoy.[4]

To determine whether animals would be protected from an experimental infection with trichinae by ingesting artificial gastric juice in which trichina-free rabbit meat had been digested, animals in tests 5b, 9b, and 10a were fed fluid obtained by artificially digesting uninfected rabbit carcasses. It will be noted that these animals were not protected, since they harbored practically as many trichinae as the controls that received no digestive fluid.

Ten tests were carried out and the results are summarized in Table 1. These data show that the test animals were protected to a greater or lesser extent against experimental intestinal trichinosis, since the test animals harbored only from 15.6 to 84.4 percent of the numbers of trichinae present in the controls. In tests 5a and 9a the digestive fluid was heated at 50°C for 30 minutes, and in test 8a it was heated at 60°C for 30 minutes, before administering it to the animals. As shown in Table 1, the animals which received the heated digestive fluid harbored from 15.6 to 43.8 percent of the number of trichinae harbored by the controls, showing that the immunizing principle was not destroyed by heating at these temperatures.

From the tests reported in this paper, it may be concluded that artificial gastric juice in which trichinous meat has been digested contains a substance capable of protecting to a certain extent, rats, rabbits, and guinea pigs from an experimental intestinal infection with trichinae. This protective substance is associated with the presence of trichinae, and is not destroyed by moderate heating. Additional investigations of this problem are in progress.

[4] McCoy, O. R. Amer. Jour. Hyg. 21: 200. 1935.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

BOTANICAL SOCIETY

270TH MEETING

The 270th regular meeting was held in the assembly hall of the Cosmos Club, January 7, 1936, President JOHN W. ROBERTS presiding; attendance 100. MARY ELIZABETH PIERCE, ARTHUR F. SIEVERS, and JESSE D. DILLER were elected to membership.

Notes and reviews.—CHARLES THOM called attention to a very complete *Medical Mycology* by C. W. Dodge. C. R. BALL called attenton to the diamond willows and passed around an interesting example from Alaska.

Program.—Notes on the annual meetings of the American Association for the Advancement of Science at St. Louis were given by: H. A. EDSON for pathology; ALICE M. ANDERSEN for physiology; S. L. EMSWELLER for genetics; NEIL E. STEVENS for general botanical matters; W. J. ZAUMEYER for virus diseases.

N. R. SMITH gave notes on the bacteriological meetings at New York City, and E. A. HOLLOWELL on the agronomy meetings at Chicago.

271ST MEETING

The 271st regular meeting was held in the assembly hall of the Cosmos Club, February 4, 1936, President JOHN W. ROBERTS presiding; attendance 93. THORA N. PLITT and DEWEY STEWART were elected to membership.

Notes and reviews.—GEORGE M. DARROW called attention to a new book, entitled *Gardens of Color* by Henslow, head of Kew Gardens.

Program.—MIRIAM L. BOMHARD: *Leaf venation—a useful criterion for distinguishing the poisonous water hemlocks from the harmless angelicas.* Publish in this JOURNAL **26**: 102–107. 1936.

SHIO SAKANISHI: *Japanese flower arrangement.*

MRS. HERBERT H. GREGOR: *Demonstrations of Japanese flower arrangement.*

272ND MEETING

The 272nd regular meeting was held in the assembly hall of the Cosmos Club, March 3, 1936, President JOHN W. ROBERTS presiding; attendance 137. OTTO BROWN, F. J. CRIDER, GUY C. FULLER, ERNEST G. HOLT, WALTER V. KELL, WILLIAM R. VAN DERSAL, and ROBERT L. WEINTRAUB were elected to membership.

Notes and reviews.—C. R. BALL called attention to the use of willow trees as roosting places for blackbirds. M. A. RAINES gave a description of sheet culture technique for growing young plants.

Program.—CHARLES R. ENLOW: *The agronomy program of the Soil Conservation Service.* In the United States, 300,000,000 acres are affected by soil erosion. Of this acreage, 50,000,000 are essentially destroyed, 50,000,000 practically destroyed, 100,000,000 almost depleted of topsoil, and another 100,000,000 now eroding. The Soil Conservation Service has at present 141 projects in operation in 41 states, covering 46,600,000 acres of land. Of this acreage, 39,700,000 are Federal land, and 6,900,000 agricultural farm lands. The extent of the agronomic work on this acreage is well illustrated by the fact that 65% of the land on the projects in seven southeastern states is in crops and pastures, and the percentage is still larger in other sections of the country.

The difficulty encountered in developing a national agronomic policy is well illustrated by the varying conditions in Region 7 (Nebraska, Kansas and Oklahoma). This region has a rainfall of from 14 to 50 inches; soils ranging from alkaline to acid; has both water and wind erosion; dryland agriculture, wheat growing, cotton growing, corn production, and general farming. The method of erosion control in use at present by the Agronomy Section consists of rearranging the farm lands to retain soil and moisture. In attempting erosion control, proper rotations, strip cropping, contour farming, pasture management, winter and summer cover crops, change in tillage methods, contouring of pastures, and reseeding of abandoned land, blow land and gullies with commercial and native grasses and other plants, are some of the principal methods of attack. Results of experiments in strip cropping and contour farming from the soil erosion Experiment Stations at Temple, Texas, Tyler, Texas, and Guthrie, Oklahoma, show these practices save much soil and water. At Guthrie, Oklahoma, cotton lost eleven times as much water by runoff as Bermuda grass and 670 times as much soil.

BURTON F. KILTZ: *Native grasses of the prairies and plains.* A recent need has appeared requiring much of the land that has been plowed in the plains states to be returned to grass. Since ordinary introduced grasses are not adapted, a study was started to determine the possibilities of the native species already present. Most of these species, contrary to popular belief, produce viable seed and have great promise for such purposes. Seed has already been collected in considerable quantities, sufficient at least to permit rather extensive tests next year. Tests already made indicate that the seed of most species can be planted successfully. The important native species that show promise are: Blue grama (*Bouteloua gracilis*), Buffalo (*Buchloe dactyloides*), Little bluestem (*Andropogon scoparius*), Big bluestem (*Andropogon furcatus*), Western wheat (*Agropyron smithii*), and Switch grass (*Panicum virgatum*). Various machines are being given a trial in the collection of seed of these grasses. Machinery ordinarily used in collecting tame grass seed appears to be satisfactory when used on native grasses.

WM. R. VANDERSAL: *Moving pictures of seed collecting in the northeastern states.*

273RD MEETING

The annual banquet and 273rd regular meeting of the Botanical Society was held in the ball room of the Kennedy-Warren Hotel, April 14, 1936; attendance 142.

Program.—H. H. BARTLETT gave an address entitled *Experiences of a plant collector in Oceania.* He also showed two movie films of Sumatra scenes.

A special meeting of the Botanical Society was held jointly with the Washington Academy of Sciences in the assembly hall of the Cosmos Club April 16, at which E. D. MERRILL gave an address entitled *Plants and Civilizations.*

274TH MEETING

The 274th regular meeting was held May 5, 1936, at 8 p.m., at George Washington University, in connection with its 4th Annual Spring Wild Flower Show; attendance 142.

Program.—EVERETT F. DAVIS: *Some aspects of black walnut toxicity, its cause and effects.*

P. L. RICKER: *Wild flower cultural preferences.* The majority of wild flowers grow in neutral soil and many do equally well in a slightly acid or

alkaline soil. A number of species require an acid soil if they are to succeed. Azaleas, Trailing Arbutus and Pink Ladyslipper are the best examples. Most plants found in oak or pine woods require acid soil and a partially shaded condition. Most native plants must be transplanted to the same growing conditions in which they are found but a number of plants like Oswego Tea, almost always found in wet places, do equally well in dry places. The Fringed Gentian prefers a wet, gravelly, acid soil covered with grass so the seedlings will be shaded the first year. It is a biennial and sowings must be made two successive years. It is difficult to transplant unless pot-grown, and then, if its taproot is broken, it will not live. The bluebonnet is an annual, prefers a sandy, acid soil and disturbing the roots seems to be fatal to it, as is the case with the northeastern Lupine, which is a perennial. The American Pasque-flower must have a very light, well-drained soil to succeed, and this should preferably be slightly acid.

PAUL W. BOWMAN: *Remarks on the 4th Annual Spring Wild Flower Show at George Washington University.*

The formal meeting was followed by a visit to the flower show in another room.

275TH MEETING

The 275th regular meeting was held October 6, 1936, in the assembly hall of the Cosmos Club; attendance 125. EDWARD P. CARTER was elected to membership.

Notes and Reviews.—W. W. DIEHL reported on the summer Mycological Foray at Mountain Lake, Va., which took place Sept. 3–5, 1936. M. B. WAITE reported that some cherry trees around Haines Point had root injury due to flood and some showed winter injury. C. R. BALL called attention to two new books: *Wild flowers of California* by Thurston, and *Pollen Grains* by Wodehouse.

Program.—W. A. DAYTON: *The range plant handbook of the Forest Service.* Now in page-proof. Consists of 339 write-ups, 58 generic and 281 specific, including brief notes on 651 other species of western range plants; illustrated by 294 pictures, mostly original. A novel feature is the lining up of the simple botanical descriptions of the key characters with the appropriate parts of the illustration, so as to be usable by persons without botanical training. Chief purpose is to evaluate for busy field administrative men of the Service the relative importance of these range plants as regards grazing, watershed protective, recreational, and other uses, and to enable ready field identification. The looseleaf feature facilitates selection and arrangement of material, as well as possible later revision and extension.

R. KENT BEATTIE: *The Dutch elm disease in Europe.* The Dutch elm disease was found in the United States for the first time in 1930. It was brought in elm logs imported from Europe. The U. S. Bureau of Plant Industry in cooperation with the Bureau of Entomology and Plant Quarantine maintains a Dutch elm disease laboratory at Oxford, England.

The elm disease was first noted in England in 1927 though it had been present for several years. It was soon found to be widespread and all efforts to eradicate or control it were soon abandoned. No research is being conducted by the British other than an annual survey to determine its rate of intensification. Serious losses have occurred. The disease has invaded the mile-long elm rows at Windsor Castle. Eighty per cent of the beautiful trees at Buxted Deer Park are dead or dying. Roadside rows in the Worcester region are rapidly going. Southeast of Cambridge the disease has already imparted a more or less treeless appearance to the region. The disease has

moved north to within 30 miles of the Scottish border. All this destruction is in spite of the fact that the English elm is not as susceptible as the American elm.

The Dutch began research on the elm disease when it was first found southeast of Rotterdam in 1919, but have made no serious effort to eradicate it. An extensive and somewhat successful program aimed at the slowing down of the disease was begun 5 years ago. This will permit more economical utilization of the dead timber.

Belgium is carrying on no research and is doing nothing to control the disease, although it is widespread in the long roadside rows of elms.

The disease was found in France in 1919 near Chalons-sur-Marne northeast of Paris. It has spread over the whole country. It is very noticeable from the railroad trains in northwest France. It is rapidly destroying the fine old elm rows at Versailles. Little research and no control measures are being undertaken in France.

276TH MEETING

The 276th regular meeting was held in the assembly hall of the Cosmos Club Nov. 4, 1936, President JOHN W. ROBERTS presiding; attendance 108. GEORGE Y. YOUNG was elected to membership.

Notes and reviews.—R. F. GRIGGS showed specimens of a sensitive plant (*Leptoglottis nuttalli* D C) new to the flora of Washington. D. H. ROSE, J. B. S. NORTON and G. H. SHULL called attention to plants blooming in the fall.

Program.—GEORGE M. DARROW: *Berry breeding.* A report was given of the progress of the raspberry and blackberry breeding work at Corvallis, Oregon, which is under the direction of George Waldo of the U. S. Department of Agriculture. The object of the work is particularly to obtain much hardier and larger and firmer red raspberries and much higher flavored blackberries.

In red raspberry crosses hardiness was found to be dominant and nearly all of the seedlings were hardier than the standard variety grown in the Northwest. In size of berry, over half of some crosses were larger than the standard variety of the Northwest and some more than twice as large. Data on inheritance of resistance to "streak" virus disease and other inherited characteristics were presented. Some discussion was given on crosses with Asiatic raspberries and a rather full discussion of crosses with the Logan and its wild relative, which has a higher flavor than all other blackberries. Inheritance of thorniness was also discussed.

KENNETH B. RAPER: *Why study a slime mold. Dictyostelium discoideum* is a member of the Acrasiales, a group of slime molds characterized by pseudoplasmodia into which great numbers of myxamoebae aggregate but do not fuse. *Dictyostelium discoideum* is unique in possessing migrating pseudoplasmodia that typically form bacteria-free fruiting structures, or sorocarps, outside the limits of the bacterial colonies in which the myxamoebae vegetate and in which the pseudoplasmodia originate. Because of the ease with which bacteria-free spores may be obtained this species is particularly well adapted for studies upon the inter-relation between slime molds of this group and the bacteria which accompany them.

Employing pure spores and pure cultures of bacteria, *D. discoideum* was grown upon hay infusion agar in pure-mixed culture with forty-eight different species of bacteria including saprophytic forms and some plant and animal pathogens. Upon richer media containing peptone the growth of the

slime mold was dependent upon a favorable H-ion concentration in the colonies of "host" bacteria, the optimum reaction being approximately pH 6.2±. The manner in which this favorable reaction is obtained is unimportant and can be attained by incorporating in the medium a sugar which the host bacterium can ferment, or by buffering and adjusting the reaction of the culture medium prior to inoculation with bacteria.

Fractions of pseudoplasmodia of different origin can be grafted together and by employing pseudoplasmodia of different color (e.g., red pseudoplasmodia produced in cultures grown upon *Serratia marcescens* and white pseudoplasmodia produced with *Escherichia coli*) the organization of the pseudoplasmodium was studied. The organization center of the pseudoplasmodium was found to reside in the apical region; it was likewise from this region that the supporting stalk of the mature fruiting structure was formed. (*Author's abstract.*)

277TH MEETING

The 277th regular meeting was held in the assembly hall of the Cosmos Club December 1, 1936, President JOHN W. ROBERTS presiding; attendance 68. H. A. JONES, H. A. BORTHWICK, KARL C. HAMNER, LAWRENCE A. SCHAAL, LAWRENCE PAUL BATJER, JOHN W. MCKAY, ALFRED E. CLARKE, and E. V. JOTTER were elected to membership.

Program.—Address of retiring President, JOHN W. ROBERTS: *The spraying of plants, botanically considered.* Spraying for the control of plant diseases became practical only after botanists had worked out the life histories of fungi causing the diseases. Much of this work was done by members of the Botanical Society of Washington. It was pointed out that while valuable work is being done on how sprays kill fungi and the effect of sprays on higher plants, much remains to be done. In work on fungicides there are many interesting and difficult problems that are strictly botanical in nature.

36TH ANNUAL MEETING

The 36th annual meeting was held immediately following adjournment of the 277th regular meeting, JOHN W. ROBERTS presiding.

MRS. AGNES CHASE read an obituary for A. S. HITCHCOCK. E. H. WALKER, C. L. SHEAR, and J. R. SWALLEN gave additional information regarding Dr. Hitchcock and his work.

E. O. WOOTON was elected to honorary membership.

The following officers were elected for 1936: President, GEO. M. DARROW; Vice-President, G. F. GRAVATT; Recording Secretary, H. H. MCKINNEY; Corresponding Secretary, ALICE ANDERSEN; Treasurer, ANGIE BECKWITH.

Nominated for Vice-President Washington Academy of Sciences, JOHN W. STEVENSON.

G. F. GRAVATT, *Recording Secretary*